Changing Mental Models to Promote Pro-Environmental Ecosystem Management: Recreational Fishermen and Their Fish Stocking Practices in Swiss Running Waters

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Abstract

Fisheries research has discovered that the habitat situation in Swiss running waters, a parasitic fish disease and fisheries management are most likely responsible for declining fish catches in Switzerland. Regarding fisheries management, recreational fishermen (hereafter called anglers) can be considered as main stakeholders in Switzerland, who actively participate in management activities. Fish stocking (or stocking) is among the most common and widespread management tools. It can be defined as the intentional release of large numbers of fish derived from hatcheries, rearing streams or ponds into target rivers. Main motives for stocking are mitigation for human-caused habitat perturbations, restoration and conservation of stocks and harvest enhancement. While stocking is very popular among Swiss anglers and there is indication that they might overestimate its power, it is critically discussed among ecologists and fisheries scientists because it has the potential to threaten fish conservation and the sustainability of indigenous fish stocks through increased competition, loss of genetic distinctiveness and the spread of diseases and/or parasites.

The aim of the present thesis was to shed light upon the beliefs of Swiss anglers regarding stocking, with a focus on trout (*Salmo trutta*) as one of the most preferred fish species among Swiss anglers. Besides eliciting and analysing these *mental models* of Swiss anglers, this research project aimed at changing the anglers' mental models about trout and stocking to promote pro-environmental fisheries management – where appropriate and indicated.

The project this thesis bases on was designed as an interdisciplinary research project with three main stages and contributions from both fisheries science and psychology. In the first stage, the anglers' mental models of stocking, trout and trout habitat requirements and impairments were elicited and analysed with a qualitative approach (N = 12). A Swiss-wide survey (N = 418) was conducted in the second stage, primarily to validate and enhance the findings from stage I, while the biological aspect of the project focused mainly on compiling expert knowledge (based on findings from literature) of stocking, trout and trout habitat requirements and impairments. In the third project stage, stocking success controls with six different fishing clubs were conducted. The stocking success controls and the findings from stage I and II were utilised to design an intervention project, which aimed at changing the fishing club members' mental models of stocking, where indicated. The intervention project included participation in stocking success controls and detailed feedback on stocking success (through reports and a workshop). The intervention effect was measured by recurring surveys and, in the case of the workshop, flipchart protocols.

Main results from the qualitative approach in stage I were the identification of an additive and a compensatory mental model of stocking and trout stocks. While the additive mental model basically stated that stocking should be conducted independently of the degree of natural reproduction, the compensatory mental model related the need for stocking to the degree of natural reproduction and claimed that the better the degree of natural reproduction, the less stocking would be needed. Regarding the second stage, these two types of mental models could be reproduced in a larger, Swiss-wide angler sample. It could be concluded that the additive mental model was widespread among the surveyed anglers; approximately 2/3 of them could be allocated to it. Additionally, the additive mental model was associated with a higher attitude towards stocking, a higher functionality for goal achieving regarding fisheries management, a lower pro-environmental orientation and a lower risk perception of stocking compared to the compensatory mental model. Main results of the third stage were that – according to the results from the stocking success controls – two fishing clubs could continue with stocking, another two should modify stocking and the remaining two should abandon stocking. The applied intervention project was not successful in changing the mental models from the additive type to the compensatory type, although tendencies of change could be observed in relevant psychological domains and four out of six fishing clubs partially or totally followed the project's recommendations in their agreements on future stocking practice.

Overall, it could be concluded that the surveyed anglers had very detailed mental models of trout, trout habitat requirements and impairments and of stocking, which covered the compiled expert knowledge in most aspects very well. Additionally, the mental models approach proved to be very promising in generating a deeper understanding of anglers and their beliefs about stocking and processes in the stream and river ecosystem. Even though no significant changes due to the applied interventions could be observed, the intervention study resulted in valuable insights regarding the role of functionality for mental models theory and for intervention planning.

Zusammenfassung

In der Fischereiforschung wurde entdeckt, dass die Habitatsituation in Schweizer Fliessgewässern, eine parasitäre Fischerkrankung und Fischereimanagement höchst wahrscheinlich verantwortlich für abnehmende Fischfänge sind. Bezogen auf das Fischereimanagement können Hobby-Fischer (oder Angler) in der Schweiz als Hauptakteure bezeichnet werden, da sie aktiv in die Bewirtschaftung der Gewässer eingebunden sind. Eine sehr verbreitete und übliche Bewirtschaftungsmassnahme ist der sogenannte Fischbesatz (oder kurz: Besatz). Darunter wird das intentionale, meist im grossen Stil durchgeführte Aussetzen von Fischen in Zielgewässer verstanden. Die Besatzfische werden meist in Aufzuchtsbächen oder in Zuchtanlagen aufgezogen. Hauptmotive für Besatz sind die Verringerung von durch den Menschen verursachte Störungen des Lebensraums, Wiederherstellung von Fischstämmen, Arterhaltung angestammter Arten und die Erhöhung des eigenen Angelertrages. Besatzmassnahmen sind bei Schweizer Anglern sehr populär und es gibt Hinweise darauf, dass Angler den Nutzen von Besatz überbewerten. Andererseits betrachten Ökologen und anderen Wissenschaftler aus dem Bereich der Fischerei Besatzmassnahmen kritisch, da Besatzmassnahmen das Potential zugeschrieben wird durch Konkurrenz, den Verlust von genetischer und adaptiver Vielfalt und die Verbreitung von Krankheiten und/oder Parasiten angestammte Arten und deren Erhaltung zu bedrohen bzw. zu gefährden.

In der vorliegenden Arbeit sollen die Meinungen und Überzeugungen, die Angler in bezug auf Besatz haben, beleuchtet werden. Besonderes Augenmerk wird hierbei auf die Bachforelle (S*almo trutta*) gelegt, da diese zu denjenigen Fischarten gehört, die von Schweizer Anglern bevorzugt werden. Neben der reinen Erhebung und Analyse dieser *mentalen Modelle* von Anglern zielt dies Forschungsprojekt ebenfalls darauf ab, die mentalen Modelle, die Angler zu Forellen und Besatzmassnahmen haben, zu verändern und damit umweltgerechteres Handeln zu fördern – sofern eine Änderung angebracht ist.

Das Projekt, auf dem diese Dissertation basiert, war als interdisziplinäres Forschungsprojekt angelegt. Es bestand aus drei Projektabschnitten, in die jeweils Anteile aus der Fischerei-wissenschaft und der Psychologie eingeflossen sind.

Im ersten Projektabschnitt wurde ein qualitativer Ansatz gewählt, um die mentalen Modelle, die Angler bezüglich Bachforellen, deren Ansprüchen an den Lebensraum und bezüglich Besatzmassnahmen haben, zu erheben und zu analysieren (N = 12). Eine schweizweite Fragebogenumfrage (N = 418) mit dem Hauptziel, die Ergebnisse aus der ersten Etappe zu

validieren und zu erweitern, wurde im zweiten Projektabschnitt durchgeführt. Seitens der fischereiwissenschaftlichen Projektbeteiligung wurde in dieser Etappe Expertenwissen (basierend auf Literaturrecherchen) zu Besatzmassnahmen, Bachforellen und deren Ansprüchen an den Lebensraum zusammengestellt. Im dritten Projektabschnitt wurden Besatz-Erfolgskontrollen mit sechs verschiedenen Angelvereinen durchgeführt. Die Besatz-Erfolgskontrollen wurden zusammen mit den Ergebnissen aus den ersten beiden Projektabschnitten genutzt, um ein Interventionsprojekt zu planen, dass darauf abzielen sollte, die mentalen Modelle der Angler bezüglich Besatz zu verändern, sofern eine Veränderung angebracht sei. Das Interventionsprojekt war so gestaltet, dass die Angler aktiv in die Besatzerfolgskontrollen eingebunden waren und detaillierte Rückmeldungen zum Besatzerfolg (durch Berichte und während eines Abschlussworkshops) bekamen. Die Wirkung des Interventionsprogramms wurde mittels wiederholter Befragungen per Fragebogen erhoben, bezogen auf den Workshop wurden Ergebnisprotokolle auf einem Flipchart festgehalten.

Als Hauptergebnisse wurden in der ersten, qualitativen Projektetappe ein additives und ein kompensatorisches mentales Modell zu Besatz und Forellenbeständen identifiziert. Das additive mentale Modell besagt hauptsächlich, dass Besatzmassnahmen unabhängig vom Ausmass der natürlichen Fortpflanzung von Bachforellen durchgeführt werden sollten, während das kompensatorische mentale Modell den Bedarf von Besatzmassnahmen vom Ausmass der natürlichen Fortpflanzung bei Bachforellen abhängig macht. Es postuliert, dass der Bedarf an Besatzmassnahmen sinkt, je besser das Ausmass der natürlichen Fortpflanzung bei Bachforellen ist. In der zweiten Projektetappe konnten diese beiden mentalen Modelle in einer grösseren, schweizweiten Anglerstichprobe wiedergefunden werden. In den Ergebnissen hat sich gezeigt, dass das additive mentale Modell bei Schweizer Anglern weit verbreitet ist, da ca. 2/3 der befragten Angler den additiven Denkstrukturen zugeordnet werden konnten. Des weiteren konnte das additive mentale Modell mit einer positiveren Einstellung zu Besatz in Verbindung gebracht werden, ebenso wie mit einer höheren Funktionalität in Bezug auf die Erreichung von Bewirtschaftungszielen in der Fischerei, einer geringeren umweltgerechten Orientierung und einer geringeren Risikowahrnehmung bezüglich Besatz im Vergleich zum kompensatorischen Modell.

Hauptergebnisse der Besatzerfolgskontrollen im dritten Projektabschnitt waren, dass je zwei Vereinen aufgrund der biologischen Ergebnisse empfohlen werden konnte, mit Besatzmassnahmen weiterzumachen, die Besatzmassnahmen anzupassen beziehungsweise mit Besatzmassnahmen aufzuhören. Bezogen auf das durchgeführte Interventionsprojekt kann

geschlussfolgert werden, dass es nicht gelungen ist, die additiven mentalen Modelle durch Intervention in kompensatorische mentale Modelle zu überführen. Allerdings konnten Veränderungstendenzen in relevanten psychologischen Bereichen ausgemacht werden und vier der sechs teilnehmende Vereine folgten den Projektempfehlungen teilweise oder sogar vollständig in Bezug auf zukünftige Besatzmassnahmen.

Insgesamt kann festgehalten werden, dass die befragten Schweizer Angler sehr detaillierte mental Modelle zu Bachforellen, deren Lebensraumanforderungen und zu Besatzmassnahmen hatten, die die meisten relevanten Aspekte des zusammengestellten Expertenwissens gut abdeckten. Darüber hinaus hat sich bestätigt, dass der Ansatz, mentale Modelle zu analysieren sehr vielversprechend ist und ein umfangreiches Verständnis zu den Vorstellungen von Anglern bezüglich Besatzmassnahmen und Prozessen in Fliessgewässerökosystemen fördert. Auch wenn aufgrund des Interventionsprogramms keine signifikanten Veränderungen beobachtet werden konnten, hat die Interventionsstudie dennoch wertvolle Einsichten zur Rolle der Funktionalität mentaler Modelle für Theorie und Interventionsplanung vermittelt.

I. Introduction

This dissertation is entitled ‘Changing mental models to promote pro-environmental ecosystem management: recreational fishermen and their fish stocking practices in Swiss running waters’. Reading this title implies questions like ‘Why study recreational fishermen and what is fish stocking?’, ‘What are mental models?’, ‘How can they be utilised to promote pro-environmental behaviour in the sense of ecosystem management?’. And last but not least, the questions arise, how mental models can be changed and in which way they are related to ecosystem management?

In Switzerland, fisheries management has been identified as a possible reason for declining fish catches. Especially fish stocking (a common and wide-spread fisheries management tool) is more and more critically discussed among fisheries biologists and ecologist, because it has the potential to threaten fish conservation. Recreational fishermen in Switzerland are often actively involved in fisheries management (e.g. by conducting fish stocking) and there is good indication that they might overestimate the contribution of fish stocking to the overall fish population size. According to a survey, they even plan to increase their stocking activities (or want to keep it at the current level, at least). These contrasting perspectives on fish stocking build the framework of an interdisciplinary research project, where *both* fisheries biology and environmental psychology were involved. While the main aspect of the biological part contained the assessment of fish stocking by e.g. conducting stocking success controls and assessing the quality of fish habitats, the environmental psychological part focused on Swiss recreational fishermen’s beliefs or *mental models* of trout, trout habitat requirements and impairments, and of stocking. Thus, the psychological part was assessing the human dimension in fish stocking and fisheries management. With this focus on recreational fishermen’s beliefs, it was the aim of the psychological part to a) elicit recreational fishermen’s mental models and thus generate a more comprehensive and deeper understanding of their preferences in fisheries management and b) to use these gained insights for preparing and applying intervention that is suitable for promoting pro-environmental fisheries management behaviour. With this approach, the environmental-psychological part was actively contributing to solving problems and conflicts deriving from the above-mentioned contrasting views from scientists and recreational fishermen on fish stocking and fisheries management.

This dissertation bases on the psychological part of the above-presented interdisciplinary research project. Thus, it will emphasize the environmental-psychological part, whereas the biological aspects will only be thematised in a degree that is necessary for understanding.

II. Relevance of Fisheries Management and Mental Models in the Framework of Environmental Psychology

According to provide general understanding of this research topic, it will be pointed out first, why fisheries management and fish stocking (in short 'stocking') as a common and wide-spread management tool (Lorenzen, 2005; Moloney, Lenanton, Jackson, Norris, 2003) is relevant for research and applying interventions in the field of resource and ecosystem management (chapter II.1 Recreational fishermen, fish stocking, and fisheries management). Second, the mental models approach will be detailed by presenting general findings and theories in mental models research, by depicting the latest findings in the research field, and by explicating the feasibility of choosing the mental models approach (chapter II.2 The mental models approach). Additionally, the mental models approach will be examined with a focus on intervention planning in chapter II.3.

Finally, at the end of chapter II, the research questions derived from the relevance of the research topic and according to findings in mental models research (chapter II.4) are presented.

II.1 Recreational Fishermen, Fish Stocking, and Fisheries Management

Recent research has shown, that serious changes in the stream and river ecosystems have occurred (Trägerschaft des Projekts Netzwerk Fischrückgang Schweiz, 2004). The decline in the inland fish catches (Welcomme and Bartley, 1998; Burkhardt-Holm, Giger, Güttinger, Ochsenbein, Peter, Scheurer, Segner, Staub, and Suter, 2005) and declining fishing quality in general (Molony et al., 2003) have become topical issues in many countries. In Switzerland, for example, catches of brown trout (*Salmo trutta*, hereafter called 'trout') have decreased by more than 60% since 1980 (Burkhardt-Holm et al., 2005). Further research discovered three most likely reasons for the declining fish catches. Besides the habitat situation (e.g. morphology and water quality) in Swiss running waters, and a parasitic fish disease (for details see Wahli et al., 2002), fisheries management was identified as a major impact factor (Burkhardt-Holm et al., 2005). In the present thesis, fisheries management will be focused on

as a direct, human-caused impact on stream and river ecosystems. Regarding fisheries management, recreational fishermen (hereafter called 'anglers') are dominating the inland fisheries sector in many industrialized countries (Welcomme and Bartley, 1998; Arlinghaus, Mehner, and Cowx, 2002) and can therefore be considered as main stakeholders. The extent to which anglers are directly involved in fisheries management has been analysed by Welcomme and Bartley (1998), and by Arlinghaus and Mehner (2005), who defined anglers as key players in inland fisheries management. Anglers are direct users of stream and river ecosystems and at the same time involved in ecosystem management. It can be concluded that anglers are the sole fisheries users in Swiss running waters and fishing clubs actively participate in stocking and other fisheries management activities. According to Granek, Madin, Brown, Figueira, Hogan, Kristianson, de Villiers, Williams, Post, Zahn, and Arlinghaus (2008), anglers can contribute to fisheries conservation. On the other hand, they also have the potential to threaten stream and river ecosystems and biodiversity through exploitation and fisheries management (Cooke and Cowx, 2006; Lewin, Arlinghaus, and Mehner, 2006; Granek et al., 2008).

Stocking is one of the most widespread management tools and very popular among anglers (Cooke and Cowx, 2006; Moloney et al., 2003). It can be defined as the intentional release of large numbers of fish into a water body. According to Molony et al. (2003), anglers consider stocking as the ultimate and immediate solution for declining fishing quality. Among the main motives for stocking have mitigation for human-caused habitat perturbations (e.g. lack of spawning sites), restoration (e.g. stock recoveries after fish-kills or habitat improvements), conservation (e.g. retaining populations threatened by extinction), and harvest enhancement been identified (Cowx, 1999; Arlinghaus et al., 2002; Holzer , Renz, and Staub, 2003; Baer, Hanfland, Lemcke, Meyer, and Zahn, 2007). Figure 1 depicts the process of stocking assessed in this thesis.

Figure 1. The stocking process. Small trout are first caught in a small rearing stream/brook (A), collected in transport tanks (B), measured and weighted (C), marked (D), transported to the target water body (E), and finally released into their destination (F). Step C and D are usually skipped, except when conducting stocking success controls or population monitoring.

In Swiss running waters, trout are the most commonly caught fish species by anglers (Burkhardt-Holm et al., 2005). Trout for stocking usually derive from parents, which were caught from the wild or held in hatcheries. Their offspring is reared to a certain age in hatcheries or (semi-) natural rearing streams and ponds. The number of stocked fish is remarkable. Cooke and Cowx (2006) estimated that approximately 40 billion fish are stocked annually in European fresh waters and pointed out that a similar stocking scale is common around the world. Focussing on Switzerland, the Swiss Federal Office for the Environment (FOEN, 2006) reported that nearly 660 million fish were stocked in 2004, and stocking is conducted in 88% of almost 3000 Swiss stream and river sections listed in the national fisheries statistics. Between 2001 and 2006 an average of 71 million trout fry equivalents (of different age, mainly fingerlings[1]) were stocked annually in Switzerland (FIBER, 2008). In general, mainly juvenile, young-of-the-year trout are stocked.

Besides these findings from fisheries management and fish ecology, the decline in fish catches and stocking as a common fisheries management tool used by anglers and fishing clubs has even gained entry into the yellow press, at least in Switzerland. In a recent issue of '20 Minuten', a Swiss boulevard magazine, was the (non-successful) effort of a Swiss

[1] A fingerling is defined as a young or small fish, especially a young salmon or trout.
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recreational fishing club to countermeasure declining fish catches by conducting fish stocking thematised (20 Minuten, 2009). This indicates that stocking and declining fish catches are a relevant topic not only for anglers or researchers, but that it also has significance for a larger population.

However, stocking and its impact on stream and river ecosystems as well as its success or failure has been pursued mostly uncritically in the past (Cowx and Gerdeaux, 2004; Welcomme and Bartly, 1998), but is recently increasingly questioned by fisheries biologists and ecologist (Lorenzen, 2005; Cooke and Cowx, 2006). In particular, from a scientific point of view, fish stocking is considered as a potential threat to fish conservation and sustainability of indigenous fish stocks. As Cooke and Cowx (2006), and Lewin, Arlinghaus, and Mehner (2006) have pointed out, stocking can harm native fish stocks through increased competition (between and within fish stocks), loss of genetic distinctiveness (e.g. through hybridization), and through the spread of diseases and/or parasites.

Referring to the anglers' management behaviour, Burkhardt-Holm et al. (2005) concluded that stocking success controls are rarely conducted and that the contribution of stocking to the overall size of trout stocks is likely overestimated. Furthermore, a survey study by Schwärzel-Klingenstein, Lüthi, and Weiss (1999) showed that Swiss anglers intent to continue stocking or even plan to increase it, despite of lack of success or proven failure.

According to these findings, we can summarize that anglers are directly involved into stocking activities, have a very positive opinion of stocking and stocking success, and intent to continue with stocking or even plan to increase their stocking activities. On the other hand, research in fisheries management and ecology clearly indicates that stocking benefits are likely overestimated, stocking success controls are rarely done, and that stocking can be considered as a possible threat to fish conservation through increased competition, loss of genetic integrity and the possible spread of diseases and parasites. Thus, it can be concluded that stocking might not be the most pro-environmental management tool.

Within this framework the question arises, how the results-from-research contrasting view of anglers on stocking can be assessed and a more pro-environmental fisheries management can be promoted among them. Analysing anglers' mental models of trout, trout habitat requirements and impairments as well as of stocking as a management tool is a promising approach for getting a more comprehensive and deeper understanding of the anglers' beliefs. This approach will be detailed in the following.

II.2 The Mental Models Approach

According to Beierle (2002) stakeholders play an important role in practical ecosystem management, and have therefore become increasingly involved in environmental resource management research. Stakeholder participation for attacking environmental problems, which are often complex, multi-scale, and affect multiple actors, is increasingly used in environmental policy- and decision-making (Reed, 2008; Reed, Graves, Dandy, Posthumus, Hubacek, Morris, Prell, Quin, and Stringer, 2009).

In general, the management of natural resources and human (management) behaviour are common and relevant topics to environmental and social psychology (Gifford, 2009; Jager and Mosler, 2007; Morrison, 2002). In a recent issue of the Journal of Environmental Psychology, Gifford (2009) pointed out that analysing mental models could be considered as one of the future research directions in the field of environmental psychology.

Mental models have been utilised in diverse psychological disciplines. According to Krapp and Weidemann (2001), mental models in pedagogical psychology are associated to theories of knowledge-building, and Schnotz (1988) demonstrated how mental models contribute to reading, learning, and to understanding text and meaning. Norman (1983) described the role of mental models for human interaction with the environment and for problem solving. Johnson-Laird (1983, 2001, 2006) and Williams, Hollan, and Stevens (1983) focussed on mental models and human reasoning, while Breakwell (2001) addressed her research to mental models in the framework of hazards, intervention and identity processes. Bostrom, Atman, Fischhoff, and Morgan (1994), Atman, Bostrom, Fischhoff, and Morgan (1993), and Morgan, Fischhoff, Bostrom, and Atman (2002) applied mental model research to risk communication. Further, Kolkman, Kok, and van der Veen (2005) introduced the mental models approach to support and enhance decision-making in integrated water management, and Schöll and Binder (2009) recently used a structured mental model approach to compare experts and farmers' system perspectives regarding the role of livelihood assets in risk perception. Additionally, Kaplan and Kaplan (2009) pointed out the benefits of assessing mental models for the whole research area of environmental psychology and based their reasonable person model (Kaplan and Kaplan, 2003, 2009) on the mental models approach.

As can be seen, analysing mental models has become a challenge in a wide research field. However, this wide utilisation and application of the mental models approach makes it challenging to give a precise definition of what mental models are. Nevertheless, in the following a definition of mental models according to Häcker and Stapf (1998a, b) will be given (subsection II.2.1). This definition will be enhanced by a detailed view on mental

models in interaction with the environment (II.2.2), on their role in reasoning and their supposed structure (II.2.3), on their utilisation in risk communication and in intervention design (II.2.4), as well as on the reasonable person model as a larger framework (II.2.5).

II.2.1 Definition of mental models

In general, Häcker and Stapf (1998a) defined mental models as subjective functional models for technical, physical, social and complex processes (Häcker and Stapf, 1998a, p. 532), which inherit the characteristic to scale quantitative relations to qualitative relations, to reduce complex state of affairs to a manageable information as well as enabling the building of analogies through taking recourse to previous experiences and knowledge (Häcker and Stapf, 1998a, p. 532). Mental models can be considered as internal representations of state of affairs in general, which content beliefs about a system and its processes (Häcker and Stapf, 1998b, p. 410). Further, Häcker and Stapf (1998b) postulated that mental models represent state of affairs analogue to their real-world-structure and –function in a so called internal object. This internal object, in turn, is used by the cognitive system as a fundament for orientation in the real world. Thus, mental models enable people to plan action, anticipate outcomes of specific behaviours, and to mentally simulate alternative scenarios.

The physical and physiological structure of a mental model is independent from its content, because mental models have inherent structure- and function characteristics (Häcker and Stapf, 1998b). New information gains entry into a mental model not only through logical reasoning, but also through (mental) manipulation of system-characteristics, which could e.g. be initiated by the perception and exploration of real-world system reactions or by mental simulation. In other words: through gaining experience by interacting with a system or by anticipating system reactions.

Additionally, Markman and Gentner (2001) distinguished between logical and causal mental models. Referring to these authors, logical mental models can be understood as *ad-hoc* generated reasoning models, while causal mental models are considered as structures in the long-term memory (Markman and Gentner, 2001, p. 229).

II.2.2 Mental models and interaction with the environment

Norman (1983) investigated human error in human-machine interaction scenarios and focussed in his analyses on the study of participants' mental models. He stated that 'peoples' view of the world, of themselves, of their own capabilities, and of the tasks that they are asked to perform, or topics they are asked to learn, depend heavily on the conceptualizations that

they bring to the task' (Norman, 1983, p. 7). Theses aspects are represented in mental models, which are gained or are created from interaction with technological artefacts, with other people or with the environment in general. Additionally, this interaction does not only initiate the creation of a mental model of the self-conceptualisation of a person, but also of a mental model of the system a person is interacting with. Regarding the function of a mental model, Norman came to a similar conclusion as Häcker and Stapf (1998a, 1998b): mental models enable persons to anticipate and to understand interactions in general (Norman, 1983).

When analysing and investigating mental models, Norman distinguished four aspects, which he called the 'target system', the 'conceptual model', the 'mental model', and the 'scientist's conceptualization' (p. 7). The **target system** is defined as the system with which there is interaction. Usually, this is the system a person focuses on when learning about it or exploring system reactions and processes. The **conceptual model** can be understood as a technical accurate, consistent, and complete representation of a target system. Norman pointed out that conceptual models are utilised when teaching system processes or knowledge or when scientists or engineers create models. According to Norman (1983) are **mental models** 'naturally evolving models' (p. 7). This means, that people create a mental model of a system through interaction with this system. Norman emphasised that mental models are usually not technical accurate, but that the functionality of a mental model is a necessity. Functionality in this sense means that a mental model has to prove to be suitable for problem solving within its specific context (Norman, 1983). If a mental model fails to be functional, it will be continuously modified until it leads to getting a workable and/ or desired result. However, the state of elaboration of a mental model is limited by a person's background knowledge, and by previous experience regarding comparable systems. Additionally, Norman assumed that the structure of the human information processing system in itself could be considered as a constraining factor (Norman, 1983, p.8). The last aspect, the **scientist's conceptualization** was defined by Norman as 'obviously, a model of a model' (p.8). Thus, it refers to a model on a meta-level, which consists of information and knowledge on models.

As a general conclusion regarding mental models analysis, Norman (1983) summarised his findings as follows. He stated that anticipation through mental simulation is very demanding, and therefore people are very limited in it. Additionally, he found in his research that mental models used to be incomplete and unstable (p.8). By unstable, Norman meant that details of a system are forgotten, especially when there was no interaction for a long period of time with that system. He also pointed out that mental models for similar or comparable systems are often mixed-up and that people keep to behaviour patterns, even if they know that these

specific behaviour patterns do not contribute to the mental models' functionality regarding a specific outcome. As a main reason for this, Norman (1983, p.8) stated that these 'superstitious behaviour patterns' (p.8) are maintained because a change would cost more mental effort than physical effort is needed for carrying out the behaviour. Regarding action planning, Norman has observed that people prefer conducting more steps in accomplishing a task than would be needed by mentally planning first. By this, mental complexity and the chance of getting confused are reduced (Norman, 1983, p.8). As a concluding remark, Norman stated that '[…] most peoples' understanding of the devices they interact with is surprisingly meager, imprecisely specified, and full of inconsistencies, gaps, and idiosyncratic quirks' (Norman, 1983, p. 8).

Thus, it can be concluded, that mental models do not have to represent target systems or conceptual models necessarily precise or accurate, although they can be functional at the same time. Referring to this, Norman introduced a second dimension into mental models theory: he assumed that mental models do not only contain the beliefs about a system and system process, but also information about the degree of certainty and functionality regarding these beliefs (Norman, 1983). If a mental model contains a lot of uncertainty regarding a specific system, people tend to rely on behavioural heuristics and act very cautiously.

Besides summarising the results from his studies, Norman (1983) pointed out how mental models (of technical systems) could be changed through teaching. He referred to the conceptual model of a target system and stated, that teaching materials and instructions must fulfil the criteria of learnability (the learning person must be able to understand the conceptual model), functionality (the taught model's functionality must be powerful, so it can be used to anticipate correct outcomes with a high likelihood), and usability (it should be easy to apply, and must not be too complicated) (Norman, 1983, p.13).

II.2.3 The structure of mental models

The mental models approach is widely used in the research field of human reasoning. Williams, Hollan, and Stevens (1983) defined mental models as consisting of 'autonomous objects', which are associated to a certain topic. They can be used for qualitative inferences and it is possible to 'decompose' them (Williams et al., 1983). According to Williams et al., the concept of autonomous objects is central for mental models. An autonomous object is defined as a mental object, which possesses an explicit representation of state and contains information to which other autonomous objects it is topically linked, along with other relevant parameters for the specific topic it belongs to. Additionally, Williams et al. (1983) postulated

that autonomous objects are associated to rules, which define their 'behaviour' and specify how their internal parameters are changed. Thus, a mental model is a collection of topically associated autonomous objects. Williams et al. (1983) specified mental simulation or anticipation as a modification of the set of an autonomous object's internal parameters, which in turn reacts according to its internal rules and thus leads to a specific target state. Autonomous objects possess the ability to exchange changes in their parameters with topically associated autonomous objects using so-called 'ports'. Williams et al. (1983) supposed that autonomous objects are limited to a maximum of three to four ports, which they determined as an important factor in analysing peoples' mental models. They pointed out that mental simulation might be initiated anywhere in the mental model, where an autonomous object changes its internal parameters. A change in the internal parameters is an autonomous object's reaction to external conditions (Williams et al., 1983, p. 136).

The main function of mental models is according to Williams et al. (1983) its role in human reasoning. Mental models communicate the effects of changes in a system (p. 133). Additionally, the authors concluded that mental models are mainly used as '[…] inference engines to predict behavior […]' (Williams et al., 1983, p. 135), for finding explanations and justifications, and last but not least, they can serve as mnemonic devices, and thus support remembering.

Although Williams et al. (1983) defined that mental models consist of topically associated autonomous objects as smallest units, they assumed that even the autonomous objects could be decomposed to underlying, second-order mental models, which consist again of second-order autonomous objects. By this process of decomposing, new information gains entry into the original mental model. Williams et al. (1983) referred to this process as 'embedding' (p.135). A short example illustrates this decomposing-embedding process: A person possesses a mental model of a system X ('the stream and river ecosystem'). The content of this mental model X is defined by a certain number of autonomous objects $x_{1…n}$, thus $X = x_{1…n}$ ('The stream and river ecosystem consists of water quality (x_1) and fish health (x_2)'). The autonomous objects x_1 and x_2 are topically associated to each other through ports ('the better the water quality, the better the health of fish', 'manipulation of water quality is associated with a change in fish health'). If an autonomous object is decomposed, by e.g. making it to the primary target system in the sense of Norman (1983), it disintegrates into a second-order mental model with second-order autonomous objects. For decomposing x_1, this could be achieved by asking 'Within the conception of stream and river ecosystems, what exactly is water quality?'. Thus, x_1 becomes the mental model Y ('Water quality'), which might e.g.

consist of the autonomous objects y_1 (chemical load), y_2 (water temperature), and y_3 (oxygen concentration). As a result of this process, the autonomous objects of Y are embedded in the original mental model X, which in turn can now be defined as $X = x_{1\ldots n} + Y = {}_{y1\ldots n}$, or in other words 'The stream and river ecosystem consists of fish health and water quality, whereas the latter can be understood as the interaction of chemical load, water temperature, and oxygen concentration'.

Referring to reasoning in the field of language and consciousness, Johnson-Laird (2006) defined mental models as 'A representation of the world that is postulated to underlie human reasoning; a model represents what is true in one possibility, and so far as possible has an iconic structure' (p. 428). This iconic structure can be understood as a correspondence between the (spatial) real-world structure represented by a mental model and its internal structure of relations (Johnson-Laird, 2006). Further, he linked mental models to knowledge and stated that they represent knowledge in the long-term memory, which is congruent with Markman and Gentners (2001) definition of a causal mental model. Additionally, Johnson-Laird (2006) pointed out that mental models derive from perception and understanding (p.428). A fundamental principle in mental models is the 'principle of truth' (Johnson-Laird, 2006, p. 112). By this principle is meant that mental models represent what is true from a persons' point of view instead of representing which relations are false or wrong.
The general function of mental models lies in their central role for representing objects and systems, state of affairs, knowledge about processes in the world as well as representing 'the social and psychological actions of daily life' (Johnson-Laird, 1983, p. 397).

II.2.4 Mental models in risk communication and intervention design

Morgan et al. (2002) have presented an approach of designing risk communication by analysing mental models. Morgan et al. (2002) defined mental models as containing the 'fragmentary beliefs' (p.21) people use for making inferences and conclusions. This very vague definition is supplemented with the remark, that mental models are not formal models with a strict relation between real-world objects and elements in the mental model (Morgan et al., 2002). Furthermore, Morgan et al. (2002) argued that even though mental models do not provide people with direct combination rules for elements in the model, they help people to judge how things in the world interact with each other.
As Morgan et al. (2002), Atman et al. (1993), and Bostrom et al. (1994) have described, assessing mental models aiming at enhancing peoples understanding and reaction to risk is a

very promising approach. Morgan et al. (2002) integrated assessing mental models in their 'five-step method for creating and testing risk messages' (p.20), where mental models play a central role in risk communication design. Atman et al. (1993) and Bostrom et al. (1994) have published a similar guideline for designing written risk communication (the five-step method will be referred to in detail later in chapter II.3.3).

Breakwell (2001) described how mental models could contribute to optimising strategies for interventions and communication regarding risks. She defined mental models as social representations, which are elaborated in subcultures and utilised by them. By this, Breakwell (2001) related mental models to groups and not exclusively to individual persons. Breakwell (2001) pointed out, that there is a certain variability in the mental models of subcultures, which is predictable by identity processes. With this, Breakwell (2001) referred to Moscovici (1988), who identified three types of mental models within subcultures. Moscovici (1988) distinguished between hegemonic, emancipated, and polemical social representations (or mental models). Hegemonic mental models are valid for all members of a group, but they do not necessarily have been created by the group. They might also come from other sources of information or have been adopted from other groups. The hegemonic model is coercive and uniform for that group (Breakwell, 2001). Regarding emancipated types of mental models, Moscovici (1988) stated that different versions of circulating ideas and knowledge are used by subgroups to create an own version of a mental model. The beliefs in the subgroup's mental model are shared between the members of that group. The third type of mental model, the polemical representation, is created through social conflict and controversies (Moscovici, 1988). These mental models are only shared by parts of a society. Moscovici (1988) defined the relationship between their members as antagonistic and mutually exclusive (p.221).
According to Breakwell (2001), communication and intervention has to be adopted to fit the type of mental model best, when aiming at changing or correcting a mental model. Thus, Breakwell (2001) concluded that there are three different strategies for changing mental models according to the type of mental model. First, in the case of a hegemonic mental model, Breakwell (2001) recommended to present to the target group that

- the creator of the hegemonic mental model changed the beliefs represented in the model
- a change in the target group's mental model is supported by another source, which is equally powerful compared to the 'old' source

- there is an informational and motivational basis for rejecting the original mental model.

Second, according to Breakwell (2001), if an emancipated model type could be identified for the target group, intervention has to

- emphasise the self-interest of the target group, focussing on the need for a change in the prevalent mental model to better meet the groups interest
- encourage discussion within the target group about the needed change
- guide group processes to support a promotion of the new model.

Breakwell (2001) emphasised that the discussion process within the target group is essential for successfully changing a mental model. In the case of an emancipated mental model, intervention will be likely changing a mental model when the change-process is initiated within the target group, and thus perceived by the target group as being created by itself.

Third, if the target group's type of mental model can be identified as a polemic mental model, intervention should primarily focus on solving the conflict that lead to the polemic type of model (Breakwell, 2001). Alternatively, Breakwell (2001) stated that intervention could also show the target group how changing the mental model in the desired way could support and serve the target group's interests even better than the old model did.

Breakwell (2001) argued that not only the type of mental model (hegemonic, emancipated, or polemic; see also Moscovici, 1988) influences, whether intervention will be successful or not, but also that a persons identity has to be considered. Identity and mental models are strongly linked to each other and intervention has the potential to threaten principles of identity. Thus the impact of intervention might be lowered (Breakwell, 2001). In her identity process theory, Breakwell (2001) described five dimensions that define a person's relationship to any mental model. These five dimensions are awareness, understanding, acceptance, assimilation, and salience.

The **awareness** of a person is affected by the significance that the beliefs in a mental model have for that person. Thus, if a person learns that certain representations gain more significance e.g. due to information, the level of awareness rises. In general, the level of awareness ranges from 'target system is unknown' to 'expert knowledge'.

Referring to **understanding**, Breakwell (2001) explained that people differ in the degree to which they understand a mental model. The degree of understanding is lowest if a person can reproduce a mental model but cannot explain how beliefs are interconnected and interrelated. It is highest, if a person can perfectly make clear how all elements belonging to the model are

related to each other. A minimum requirement for understanding is that a person has to be aware of the existence of the mental model.

Breakwell (2001) pointed out that a person with a low level of **acceptance** knows that certain beliefs in a mental model are true for the majority of people, but still rejects the validity of the belief for him/herself. In contrast, a high level of acceptance leads to acknowledgement of the validity of a belief. Breakwell concluded that 'the extent to which the personal representation echoes the social representation reflects in part the degree to which the latter is accepted' (p.346). Additionally, a person can have contradicting mental models at the same time, which differ in their degree of acceptance (e.g. when a person belongs to several subgroups).

Assimilation was defined by Breakwell (2001) as the integration of a not accepted mental model into pre-existing personal mental models. Thus, a personal mental model can be considered as unique, because it is developed on personal, idiosyncratic experiences of a person in combination with assimilated parts of a societal existing mental model (that is e.g. a shared belief in society). According to Breakwell (2001), social processes ensure that the personal mental model is related to pre-existing societal mental models, while emotional process ensure the linkage to pre-existing personal mental models.

The last dimension that defines a person's relation to a mental model is called '**salience**'. According to Breakwell (2001) it could be understood as a degree of personal significance of a mental model. Thus, the salience varies between and within people, depending on the situation they are in and on their intentions. Breakwell (2001) assumed that the salience of a mental model influences how precise a mental model is and how completely it mirrors the target system. However, Breakwell (2001) denoted that she has not found empirical evidence for the role of salience.

The identity process theory (Breakwell, 2001) stated that the above-described dimensions are determined by requirements of identity. These identity requirements, in turn, derive from people's motives to achieve continuity, distinctiveness, self-efficacy, and self-esteem as characteristics of their identity structure (Breakwell, 2001, p. 347). If these motives cannot be satisfied, then a person will perceive a threat to his/her identity. In turn, in the case of satisfaction, a person will create and use a variety of strategies to protect or regain continuity, distinctiveness, self-efficacy, and self-esteem (Breakwell, 2001).

The identity process theory and Breakwell's (2001) as well as Moscovici's (1988) definition of mental models has various implications for planning intervention aiming at changing mental models. In general, the target population must not perceive an alternative mental

model promoted through intervention as threatening identity. Details on planning intervention according to Breakwell's (2001) assumptions are presented in chapter II.3.2.

II.2.5 Mental models in a larger framework: The reasonable person model

Kaplan (2003) and Kaplan and Kaplan (2009) have developed the reasonable person model, which links human behaviour to environmental factors. The building of mental models plays a central role in this framework. Kaplan (2003) stated that information is important for human survival and that people in general are more reasonable in environments that support their information needs. These information needs can be, according to Kaplan (2003), organised in the three categories 'exploration and understanding', which concerns the acquisition and comprehension of information, 'meaningful action', which focuses on planning and engaging actions according to gained information, and last but not least 'restoration', which can be understood as the ability of maintaining one's attention and reaction on information from the environment.

In a further elaborated version of the reasonable person model, Kaplan and Kaplan (2009) pointed out that information and information processing is an important determinant for reasonable behaviour. They assumed that humans have an informational need because human survival depended and still depends on information and information processing (p. 330). For Kaplan and Kaplan (2009), fostering reasonable behaviour in itself is defined as an answer for many problems: They stated that typical *unreasonable* behaviour includes 'demanding fairness for oneself while denying it to others, displaying intolerance and disrespect for others, willingness to kill or harm because of different beliefs, and attempting to extract earth's resources for personal gain without regard for the needs of future generations' (Kaplan and Kaplan, 2009, p.330), while reasonable behaviour could be understood as acting in the opposite of unreasonableness. They assumed that unreasonableness or reasonableness is not a trait that a person has or has not. Moreover, the degree of reasonableness is a function of people's informational needs and the environment they are in. Or to be more precise, the likelihood of acting reasonable increases, if an environment supports people's informational needs. In this sense, the building of adequate and functional mental models fosters reasonable behaviour. This will be detailed in the following.

Following Kaplan and Kaplans (2009) definition of the reasonable person model, it is based on the three major domains 'Model building', 'Being effective', and 'Meaningful action', which are highly related to each other. Figure 2 visualises the reasonable person model as Kaplan and Kaplan designed it.

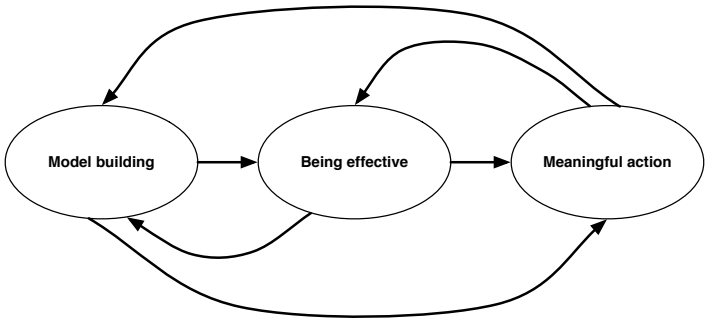

Figure 2. The reasonable person model by Kaplan and Kaplan (2009, p. 330). For acting reasonable, people have to build an adequate mental model first, experience effectiveness second, and last but not least participate in meaningful action. These three domains are highly related to each other.

For Kaplan and Kaplan the **building of a mental model** is vital. They stated that '[…] there is a need for *building mental models*. People depend on these models. This devotion is essential, since they rely on them for everything they do' (Kaplan and Kaplan, 2009, p. 330). The Kaplans defined mental models as representations of reality. These representations are simplified and part of a human's memory. Their main purpose is the evaluation of possibilities, action planning, and understanding and adding meaning to events in the world. Furthermore, mental models help in predicting future events, and mental simulation of alternative behaviours enables humans to avoid risks and failure. Thus, they contribute to act in a very effective way (Kaplan and Kaplan, 2009).

Kaplan and Kaplan (2009) linked human needs and motivations to mental models and stated that these aspects are responsible for updating and correcting mental models. As two most important needs or motivations, Kaplan and Kaplan focused on 'understanding' and 'exploration'. With respect to understanding, Kaplan and Kaplan pointed out that it could easily be achieved through educational material, brochures, and formal knowledge building. They linked 'exploration' to 'understanding' by arguing that the first thing that humans do in an unfamiliar environment is not building formal knowledge of that environment, but exploring it. Thus, exploration is the method of choice for achieving information, which in turn can be seen as a fundament for general understanding of processes and events in the environment (Kaplan and Kaplan, 2009). Furthermore, understanding in Kaplans and Kaplans sense is fundamental for a valid mental simulation (or anticipation) of most likely future events before these events happen. Thus, it is ensured by a valid and functional mental model, that a person can react on mentally simulated outcome when there is still time to act (i.e. taking countermeasures, preparing for a certain action etc.).

Referring to **meaningful action** as the second major domain of Kaplan and Kaplan's (2009) reasonable person model, it points out to be a complex set of concepts. Meaningful action is based on the human need to '[…] participate, to do things that matter, to be part of what is going on in the world around one' (Kaplan and Kaplan, 2009, p. 220). Although the aspect of participation is essential for meaningful action, a person must additionally have the perception of being heard, being listened to and being paid respect to. As examples for meaningful action Kaplan and Kaplan mentioned the process of voting or the participation in volunteer works (e.g. for nongovernmental organisations (NGOs)). Even being asked to participate in a survey study could provide people with the perception of meaningful action, if they have the feeling that they are a part of 'things that matter' (Kaplan and Kaplan, 2009, p. 332).

As a third major domain of the reasonable person model, Kaplan and Kaplan referred to the human need of **being effective**. They argued that being effective is directly linked to information management, and thus includes the two motives of 'achieving clear-headedness' and 'enhancing competence and confidence' (p.332). Achieving clear-headedness is double-edged and can be perceived as challenging. During the process of information seeking, people are at risk to get overwhelmed by the sheer amount of available information, which could lead to distress and confusion (Kaplan and Kaplan, 2009). As a second component of becoming effective, Kaplan and Kaplan referred to White's (1959) concept of competence, which emphasises the essential link between motivation and cognition. Additionally, they stated that the feeling of competence could be fostered by giving information about the larger frame in which a person's behaviour is situated. Furthermore, Kaplan and Kaplan (2009) reported that the feeling of competence is a need in itself. The process of gaining more competence is perceived as more satisfying compared to the experience of being competent. For this, they gave the example of a person who spends a lot of time on fine-tuning skills that have no importance for practice.

In summary, mental models in the larger framework of the reasonable person model play a fundamental role enabling people to act reasonable.

II.3 Implications from Mental Models Theories for Intervention Planning

Besides identifying anglers' mental models of trout, trout habitat requirements and impairments as well as of stocking, changing mental models through intervention is another main subject of this thesis. Regarding the mental models framework, theories and findings described in chapter II.2 'The mental models approach' offer a variety of implications for designing intervention studies.

In general, Williams et al.'s (1983) assumptions about the structure of mental models contribute to understand how mental models can be changed through intervention. The characteristic of being decomposable can be understood as an essential assumption about mental models: Targeting a specific autonomous object within a mental model, successful intervention has to decompose this particular autonomous object. Simultaneously, it has to create topically relations to other autonomous objects that are associated with favoured implications for the target system. With this process, favoured implications can gain entry into the original mental model through the process described by Williams et al (1983) as 'embedding'. Thus, theoretically, the favoured implications of the newly embedded autonomous object can affect the rules and internal parameters of other autonomous objects by being spread in the whole mental model through ports, which serve as connections between autonomous objects of a mental model. In other words: According to the structure of mental models stated by Williams et al. (1983), intervention has to enhance a pre-existing mental model with intervention-favoured information by utilising the 'embedding-through-decomposition' mechanism. This assumption finds support by a learning experiment conducted by Gentner and Gentner (1983), where they found out that the use of analogies does not only transfer words and descriptions to another domain, but also that structural aspects from the domain where the analogy was taken from impact (and possibly determine) the knowledge-building regarding a new domain.

Following this idea, the question arises, how intervention could initialise the decomposition of pre-existing mental models and autonomous objects. And how intervention could be designed to successfully embed favoured information into a mental model (additionally to utilising analogies from the favoured mental model)? Again, the theories presented in chapter II.2 provide clues and practical approaches for answering these questions. The intervention-relevant aspects of these theories will be detailed in the following subsection.

II.3.1 Intervention planning according to Norman (1983)

The work by Norman (1983) emphasised the role of functionality for mental models. He stated, that mental models could be defined as naturally evolving models (Norman, 1983, p. 7). The perception of a lack of or insufficient functionality initiates this evolving process (p. 7 – 8), which means that a person becomes aware that his/her mental model is not or no longer suited to achieve a desired system response. In the case of Swiss anglers and fish stocking this would mean that the anglers e.g. might loose confidence in stocking, if they experience it as not achieving mitigation for human-caused habitat perturbations, restoration and conservation of stocks, and harvest increase (see chapter II.1). Besides questioning the functionality of a pre-existing mental model, Norman (1983) postulated the criteria of learnability, functionality, and usability as requirements of a conceptual model for evoking a change in a mental model. Regarding the design of interventions to change anglers mental models of stocking this would mean that intervention has to a) provide perception and experience of stocking as not being functional for goal achieving, and b) present an alternative conceptual model, which is easy to understand, promises high functionality, and is easy to apply or implement.

II.3.2 Intervention planning according to Breakwell (2001)

Breakwell (2001) gave concrete recommendations for planning intervention suitable for changing mental models. From her identity process theory (see chapter II.2.4), it can be inferred that the relationship a person has to a mental model is essential for intervention planning. It can be hypothesised that successful intervention has to succeed in raising a person's awareness and acceptance of a mental model, has to be adapted to the degree of assimilation and should make the mental model salient before e.g. aiming at an increase of understanding.

Additionally, Breakwell (2001) explicated, that changing mental models must not threaten a person's identity requirements, e.g. by counteracting his/her motives of achieving continuity, distinctiveness, self-efficacy, and self-esteem. Taking these aspects into account, it can be assumed that an alternative mental model (the one favoured by intervention) has a good chance to gain entry into a person's belief system. Otherwise, if intervention fails to meet these requirements, conflict may arise and the type of mental model might e.g. change to a polemic mental model, which fosters a person to keep to his/her pre-existing mental model.

Breakwell (2001) proposed the following stages for intervention planning: first, the mental model of the target system should be described, followed by identifying whether it is a

hegemonic, emancipated, or polemic mental model. If done this, it should be determined in how far the mental model is consensual within the target population. In a next step, the identity requirements should be identified, which are satisfied for the target group by the prevalent mental model. After this, it should be determined which components of the mental model have to be changed, and last, it has to be decided on the detailed information content, the communication channel, and the frequency of communication when applying intervention. Regarding the planning of an intervention study with Swiss anglers, we can make some a-priory assumptions on the type of mental model: It is very likely that anglers have a emancipated type of mental model, because stocking is conducted by fishing clubs or at last in groups. Thus, mental models of stocking can be generalised within theses groups, but not necessarily between them.

II.3.3 The five-step method by Morgan et al. (2002)

Morgan et al. (2002) have presented a five-step method for designing intervention in risk communication. They have clarified that in mental models research a qualitative approach is needed first, especially if the researcher does not know every aspect and domain of the mental model under scrutiny. Additionally, they have pointed out that structured tests or closed-items, which are commonly used in questionnaires, may give hints or bias the target group's answers by introducing concepts and formulations that were originally not part of the target group's mental model. Apart from this potential bias coming from administering a structured questionnaire as a first approach for eliciting mental models, Morgan et al. (2002) gave evidence for the value of conduction open-ended interviews first. They reported that 'each time that we [Morgan et al.] have conducted mental model interviews, we have discovered surprising beliefs and formulations, begging treatment in risk communication' (Morgan et al., 2002, p.25). They concluded that a qualitative approach is necessary and recommended in general to 'Create an expert model', Conduct mental models interviews', 'Conduct structured initial interviews', Draft risk communication', and finally 'Evaluate communication' (Morgan et al., 2002, p. 20 – 21).

Creation of an expert model as the first step contains reviewing and analysing scientific knowledge about the target system. Morgan et al. (2002) recommended summarising the experts' beliefs about the system in an influence diagram, so that interpretation and drawing conclusions becomes easier. Additionally, other experts should review the expert knowledge to ensure that all relevant aspects are included. Morgan et al. (2002) emphasised, that the

expert knowledge should not be understood as superior or being truer than lay knowledge, because it only represents the *beliefs* of experts about the target system.

In the second step, **mental models interviews** should be conducted. Thus, the beliefs of the target population are elicited. Morgan et al. (2002) proposed that the interview guideline should be designed according to the content of the expert models, thus ensuring that the interview covers all relevant topics. These mental models interviews could then be used for analysing in which domain and in how far expert beliefs and the target population's beliefs differ.

The next step is designed to **conduct structured initial interviews** (Morgan et al., 2002). Although the name is slightly misleading, the main goal of this step is to estimate the prevalence of the beliefs captured in the mental models interviews in the intended target population by conducting a survey study. However, after having identified the target groups' most common (mis-) conceptions, a 'confirmatory questionnaire' (p.27) should be created, which can be applied to test the in the interviews identified conceptions on a larger scale (Morgan et al., 2002). A confirmatory questionnaire should, according to Morgan et al. (2002), contain items addressing the most important beliefs, significant misconceptions, and in the case of risk communication, critical terms that describe the risk.

In the **draft risk communication** step the results from both the previous conducted mental models interviews and the confirmatory questionnaire survey are analysed in the framework of decision-making (Morgan et al., 2002). This step identifies the most relevant misconceptions and beliefs significant for decision-making in the target population, and thus it defines the main intervention goal. Morgan et al. (2002) recommended creating a communication draft that is reviewed by experts according to its accuracy.

The **communication is evaluated** in a final step. By this, Morgan et al. (2002) meant that the intervention (or communication) should be pre-tested to acquire information about its impact and understandability. Regarding the pre-tests, Morgan et al. (2002) proposed to conduct one-on-one read-aloud interviews, focus groups, closed-form questionnaires, and/or problem-solving tasks where appropriate with selected persons from the target population. This step ensures that the intended intervention is appropriate for the target group and that it impacts the identified, most relevant misconceptions and beliefs.

II.3.4 Intervention planning in the framework of the reasonable person model

Kaplan and Kaplan's (2009) reasonable person model bases on the three concepts of 'mental model building', 'being effective', and 'meaningful action' as fundaments for reasonable

behaviour (see II.2.5). Thus, it can be concluded that intervention suitable for changing mental models (aiming at promoting a more pro-environmental behaviour) can also be based on these three pillars.

Regarding Kaplan and Kaplan's assumption, that mental models are created through understanding (which derives from experience and knowledge), it can be argued that experience and knowledge can also *change* a pre-existing mental model. This is congruent with findings from other mental model theories, e.g. the statement by Norman (1983), who defined mental models as naturally evolving models, or Johnson-Lairds' (2006) assumption that mental models derive from perception and understanding (p. 428). Thus, intervention designed to impact the anglers' stocking experience should be suited well for initiating a change in the anglers' mental model of stocking. Further, it can be hypothesised, whether the intervention succeeds in decomposing the mental models (in the sense of Williams et al., 1983) depends on the experience the anglers make due to an intervention.

According to Kaplan and Kaplan (2009), being effective is another main requirement for reasonable behaviour. The concept of effectiveness is defined as gaining competence and by increasing skill, so that a person experiences her/himself as becoming more and more effective in achieving intended goals (Kaplan and Kaplan, 2009). Thus, the concept is very near to functionality in the sense of Norman (1983) and to the definition of the role of mental models by Morgan et al. (2002), who stated that they provide people with general principles about how things in the world are interrelated (p. 22). Following the notion that people want to be effective by increasing their skills (Kaplan and Kaplan, 2009), it can be assumed that intervention should also aim at the functionality of stocking. Thus, if stocking is perceived as not being functional for achieving the intended goals, anglers are likely to loose their feeling of being effective when conducting stocking.

With respect to meaningful action as the third pillar in the reasonable person model (Kaplan and Kaplan, 2009), implications for intervention are not obvious. While mental model building depends on understanding and experience, being effective on the perceived functionality of a mental model, the meaningful action can be experienced through manifold aspects. Kaplan and Kaplan (2009) stated that it is a 'complex set of concepts' (p. 331) and that 'participation is at the core of what we [Kaplan and Kaplan] call meaningful action' (p.332). It can be concluded that both conducting stocking as well as being involved in intervention might be perceived as meaningful action. Therefore, intervention based on meaningful action cannot easily aim at questioning or enhancing meaningful action.

Moreover, the fact that stocking is an activity were anglers participate in (Burkhardt-Holm et al., 2005) can be seen as a demand for intervention to be designed as a participative action.

Overall, summarising the implications for intervention for changing anglers' mental models of trout, trout habitat requirements and impairments, and of stocking, conducting stocking success controls together with anglers seems to be the most promising approach: By this, anglers could make experience regarding the functionality of stocking, which they usually do not have (Burkhardt-Holm et al., 2005). The anglers could perceive meaningful action through participating in the stocking success controls, and by giving them feedback and recommendations regarding their stocking behaviour they could increase their feeling of being effective. In the case of stocking resulting in perceived failure, presenting and discussing recommendations for stocking can also be seen as presenting the anglers an alternative model (the recommendation) with likely higher functionality compared to the old stocking process. On the other hand, in the case of perceived stocking success, the intervention might fortify the pre-existing mental model. Nevertheless, if people really rely on their mental models for everything they do (Kaplan and Kaplan, 2009), participative intervention based on mental models promises to be a very powerful approach in changing a target group's beliefs and behaviour.

II.4 Research Questions

Summarising these selected definitions and findings from theories on mental models, it can be concluded that mental models represent the understanding of a system, processes within a system, that they build the fundament for judgement of actions and outcomes, enable persons to anticipate events by mental simulation, and evolve to maintain or enhance their functionality. The selected theories and findings from mental model's research described above clarified that mental models do usually not represent an objective reality, but a reality that is more or less valid for groups (or individuals). However, different persons and groups can have different mental models, which should correlate with their conceptualisation of a target system.

With this conceptualisation of mental models, the Swiss anglers' involvement in fisheries management and stocking provides an excellent setting for mental models research, because anglers interact with the stream and river ecosystem, which is a complex system, and have to rely on their understanding of interrelations within the system to plan and conduct stocking in such a way, that the best outcome (e.g. regarding stocking) can be expected through anticipation. Thus, they are very likely to have elaborated mental models of stocking and of processes in the stream and river ecosystem. It can also be inferred from the reasonable person model (Kaplan and Kaplan, 2009), that Swiss anglers perceive stocking as meaningful action, because they usually participate in the stocking process (at least in Switzerland). Moreover, depending on their mental model, they experience stocking as being effective, as results from Burkhardt-Holm et al. (2005) indicate. Thus, the assumption is feasible that stocking is a reasonable behaviour for Swiss anglers. In contrast, when referencing to the biological findings summarised in chapter II.1, the question arises how the stream and river ecosystem works from the anglers' perspective. In detail, this means to analyse how anglers' mental models are constituted, and how they influence the anglers' view on stocking, when stocking is perceived as reasonable behaviour while fisheries research indicates that this is likely not the case.

In particular, this contrast will be analysed in detail in chapters IV, V, and VI. First, chapter IV (entitled 'The relevance of habitat and fisheries management for brown trout stocks – an anglers' perspective') focuses mainly on the following questions:

- What do anglers think and know about trout and their habitat requirements and impairments?
- What do anglers think and know about fisheries management, with a special focus on stocking?

- Are there different subgroups within the angler population who differ significantly in their mental models of stocking?
- Where are the gaps between expert and angler knowledge regarding stocking and fisheries management?

In chapter V it will be analysed how the anglers' mental models impact ecosystem management preferences by pursuing the questions

- What are the mental models of stream and river ecosystems and trout population dynamics of Swiss anglers?
- Which relations in the mental models indicate whether stocking is seen as the most preferred management tool?
- Do anglers possess various mental models with regard to stocking?
- Do these different mental models have consequences for anglers' attitude toward stocking, preferences for management tools, and pro-ecological orientation?

Chapter VI bases on the findings reported in chapter IV and V and investigates the question, whether mental models really matter for fisheries management or not. Thus, it will be a link established to in social psychology widely used concepts of attitude and intention. Furthermore, mental models and selected assumptions of Ajzen's (1985, 1991) theory of planned behavior will be analysed using a structural equation modelling approach. Thus, the main research questions chapter VI deals with are as follows:

- Which constructs, domains and perceptions are responsible for the type of mental model an angler has?
- How are the anglers' mental models related to attitude and intention as selected aspects from the theory of planned behavior (Ajzen 1985, 1991)?
- Which role do mental models play in building attitudes toward stocking and intentions to participate in stocking?

With respect to changing mental models, it becomes apparent that a precise as possible conceptual model in the sense of Norman (1983) is needed and that especially the findings of Breakwell (2001), Morgan et al. (2002), and Kaplan and Kaplan (2009) provide a reasonable approach for intervention planning on a mental model basis (see chapter II.3). Following the implications of biological and ecological research regarding the role of stocking and its possible negative impacts on fisheries management and fish conservation, chapter VII

describes an intervention study, which aimed at changing anglers' mental models to promote a more pro-environmental fisheries management. By this, the following research question is under scrutiny in chapter VII:

- Is mental models derived intervention suitable for changing beliefs, attitude, and intention toward stocking?

Analysing these research questions contributes to gaining deeper insight in stakeholder's management behaviour, using the example of Swiss anglers and stocking as a fisheries management tool. Moreover, by using the mental models approach, not only a more comprehensive picture of Swiss anglers and stocking is gained, but also implications can be inferred for mental models research itself: thus, the application of the mental models approach can also be understood as a test of mental models assumptions from various research fields, which results in conclusions for the feasibility of utilising mental models in intervention- and environmental psychological research. Additionally, with the presented approach, future research demands in the field of mental models research can be identified.

III. Methods

This chapter first describes the design of the whole research project and gives an overview about the project timeline (III.1). In a second section (chapter III.2 and III.3) the used methods for eliciting mental models in the frame of the present study are detailed. Chapter III.4 focuses on the assessment of stocking success within this research project. Finally, in chapter III.5 the sample statistics are summarised.

III.1 Study Design & Project Timeline

For answering the above-mentioned research questions (chapter II.4), a multi-stage interdisciplinary field research project was designed. For a first orientation, figure 3 depicts the overall timeline of the present study.

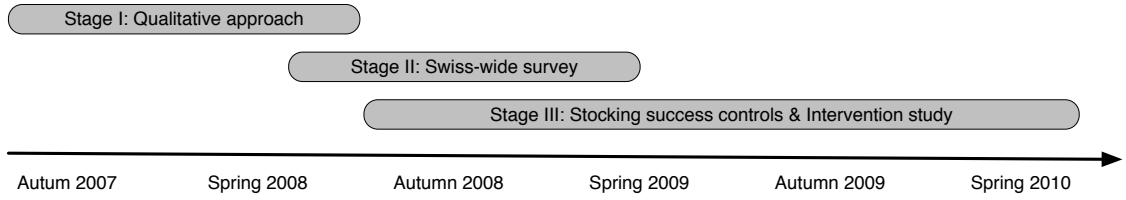

Figure 3. Overview of the project timeline. Stage I was designed as a qualitative approach to assess anglers' mental models of stocking and processes in the stream and river ecosystem, while stage II was designed as a mostly quantitative nationwide survey study. Stage III was designed as an intervention study, where stocking success was assessed to initiate a change in the anglers' mental models. Details on these stages are given in the text.

As can be seen in figure 3, the whole project was conducted within three years and the stages were partially overlapping. Stages I and II were used to collect data for answering the research questions focussed on in chapters IV, V, and VI, while the data from stage III was utilised for analysing mental models derived interventions in chapter VII. With the overall study design by first taking a qualitative approach and then focussing on a more structured, quantitative one, Morgan et al.'s (2002) recommendations for eliciting mental models were followed (see Chapter II.3.3 The five-step method).

Norman (1983) gave a warning comment on eliciting mental models in general. He stated that discovering a person's mental model is not easy from a methodological point of view. Just by asking a person, what he/she is doing and why, creates a 'demand structure' (Norman, 1983,

p.11). The demand structure pushes that person to give an answer to the question. Thus, the person is likely to create an *ad-hoc* mental model (Markman and Gentner, 2001) that only contains information about how the person answers that particular question, but not about the causal mental model (Markman and Gentner, 2001), which is considered being part of the long-term memory (e.g. Johnson-Laird, 2006), and thus a possible source for reasonable action from a person's point of view (Kaplan and Kaplan, 2009).

With Norman's (1983) warning and Morgan et al.'s (2002) recommendations in mind, the methods detailed below have been chosen as a possible best practice for eliciting mental models. The sections below give detailed information on the methods used in each stage. Details on measurements are given in the chapters IV to VII for answering each research question. Additionally, it is described in these chapters which particular methods from which stage were utilised for gathering results suitable for answering the research questions. In other words: In this general methods section, it will be focussed on the methods suitable and utilised for collecting mental models, and not on e.g. questionnaire items suitable for answering the in chapter II.4 presented research questions. The latter aspect will be part of chapters IV, V, VI, and VII, which are specially designed to examine the above-introduced research questions in detail.

III.2 Eliciting Mental Models with Qualitative Methods

In the first stage of the project, a qualitative approach was used to collect Swiss anglers' mental models and to get an orientation about the topics that are relevant for stocking and fisheries management from the anglers' point of view. According to Morgan et al. (2002), open-ended interviews will be most feasible for eliciting mental models. Additionally, Johnson-Lairds (2006) definition of a mental model was taken into account, which stated that a metal model has as far as possible, an iconic structure (p.428). This is supported by Williams et al.'s (1983) view of a mental model consisting of topically connected autonomous objects. Thus, the open-ended theme focussed interview by Witzel (1985, 2000) in combination with the 'Heidelberger Struktur-Lege-Technik' [Structure-laying-technique, SLT] by Scheele and Groeben (1988) were the methods of choice. The mode of application for both methods and the methods themselves are described in the following paragraphs.

III.2.1 Open-ended theme-focused interview

The open-ended theme-focussed interview by Witzel (1985, 2000) is a method for collecting qualitative data about a person's understanding and view of a certain topic.

In accordance with Witzel (1985, 2000), a short pre-interview questionnaire containing socio-demographic questions and items was developed and administered immediately before the interview was conducted (see appendix XIV.1.1, in German language only). Thus, the short, pre-interview questionnaire fulfilled two goals: first, it provided a thematic preparation for the participant, and second, it bridged the time the interviewer needed for setting up the equipment for the interview (e.g. the voice-recorder, interview guideline, etc.). The open-ended theme-focussed interview uses an unstructured interview guideline, which does not contain direct questions but only topics and themes that will be focussed on (Witzel, 1985, 2000). Thus, it is more a collection of topics, serving as a memory aid for the interviewer, than an interview guideline in the classical sense (e.g. Bortz and Döring, 2003). The 'guideline' for the open-ended theme-focussed interviews conducted in the present study contained topics related to intentions to do stocking and for fishing, experiences with fisheries management, conditions for a 'good' habitat, interaction of processes in the river and stream ecosystem, and diverse other fisheries related themes. The complete catalogue of topics can be found in the appendix (see appendix XIV.1.2, in German language only). The narrative answers given by the interviewee were voice-recorded using an Apple iPod® Nano in combination with a Belkin TuneTalk Stereo® microphone.

This interview set-up was pre-tested and modified according to the pre-testers' feedbacks before it was applied in the field. The interview in combination with the short questionnaire required approximately 1.5 hours, and all interviews were conducted in the interviewees' home.

Afterwards, the voice-recorded interviews were partially transcribed. This means, that they have not been analysed by using e.g. the qualitative content analysis (Mayring, 1983). Instead, for the goal of collecting the anglers' mental models, it was sufficient to record the key concepts regarding topics and processes in stream and river ecosystems and their interdependencies mentioned by the interviewee (figure 4).

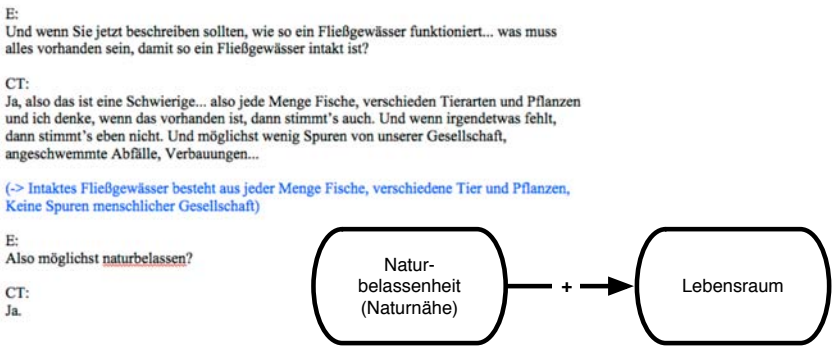

Figure 4. The process of partially transcription. Passages in the transcribed interviews were used to identify concepts and the relations between them. In this example, the interviewee stated that the habitat profits from elements that indicate a 'high degree of naturalness' (which means, that the river is in a near natural condition).

III.2.2 Structure-laying technique [SLT]

The SLT can be understood as a visualisation method for subjective theories. Scheele and Groeben (1988) pointed out that the SLT is not only appropriate for visualising scientific theories (e.g. conceptual models in the sense of Norman (1983)), but that it is also applicable for eliciting subjective theories (which can be seen as mental models in the sense of e.g. Norman (1983) or Kaplan and Kaplan (2009)). In it's original form, the SLT was designed as a participative, qualitative research instrument. Thus, a researcher would first conduct an interview to elicit a subjective theory, and then explicate the structure of the subjective theory by writing the main theories concepts on e.g. green cue cards, and the relations between different concepts on e.g. red cue cards. While doing this, the researcher and the participant discuss the concepts and their relations, and the researcher introduces a specific graphical code for different types of relations (see appendix XIV.1.3, in German language only). The concepts of the subjective theory are then connected using these graphical codes, and the complete structure is again discussed. This procedure is repeated for several times, until the participant and the researcher agree to a version that resembles the participant's subjective theory. Further details on applying the SLT can be found in Scheele and Groeben, 1988.

However, the SLT in its original form was too (time-) demanding regarding the recurring meetings and discussions between researcher and participant. Thus, a modified version of the SLT that fitted in the context of the open-ended theme-focussed interview was developed. Immediately after the interview, the interviewee was asked to recapitulate the main topics of the open-ended theme-focussed interview and to list these one by one on green cue cards (so one cue card for each topic resulted). As soon as one cue card was completed, the interviewer asked which mentioned (or still unmentioned) topics were related and how these relationships

could be described. If the interviewee did not produce a topic, the interviewer chose a topic from the interview and asked for other related topics or processes affected by this topic (for instructions and used supplementary material see chapter XIV.1.3, in German language only). The mentioned relationships were then drawn on red cue cards by the interviewer and placed between the green cards according to the interviewees' assignment. The interviewee was asked at regular intervals if the laid-out structure was complete or if there were any missing relevant relationships or topics. Once the interviewee had completed the structure, the interviewer started to summarize it and made sure he understood it correctly. If there was disagreement between the interviewer and the interviewee, the interviewer asked what was meant by the part of the structure in question, and the structure was revised, if required. Figure 5 shows a resulting structure laid by a participant.

Figure 5. Resulting structure from the application of the modified version of Scheele and Groeben's (1988) Structure-Laying-Technique.

The resulting structure was photographed, and the conversation and mentioned thoughts during its construction were voice-recorded. This application of the modified version of the SLT took between 30 minutes and 1.5 hours. All photographed structures were later transferred into formalized diagrams (figure 6).

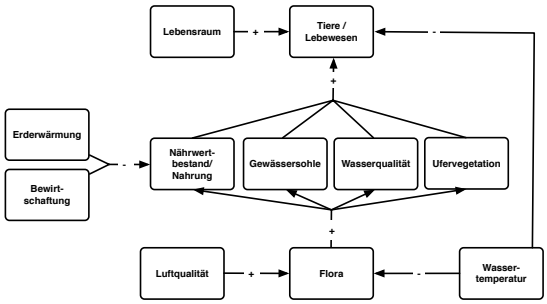

Figure 6. Example of the formalised diagram derived from the structure resulted from an application of the modified SLT (compare to figure 5). The arrows indicate the direction of influence, whereas '+' can be read as 'the more… the better for…', and '-' as 'the more… the worse for…'.

Like the open-ended theme-focussed interview, the application of the modified SLT was pre-tested and the application-process was adapted where indicated by the pre-testers.
The partially transcribed results from the open-ended theme-focussed interview could then be merged with the results from the modified SLT to reconstruct the detailed mental model of a participant. An example for this merging process is displayed in figure 7.

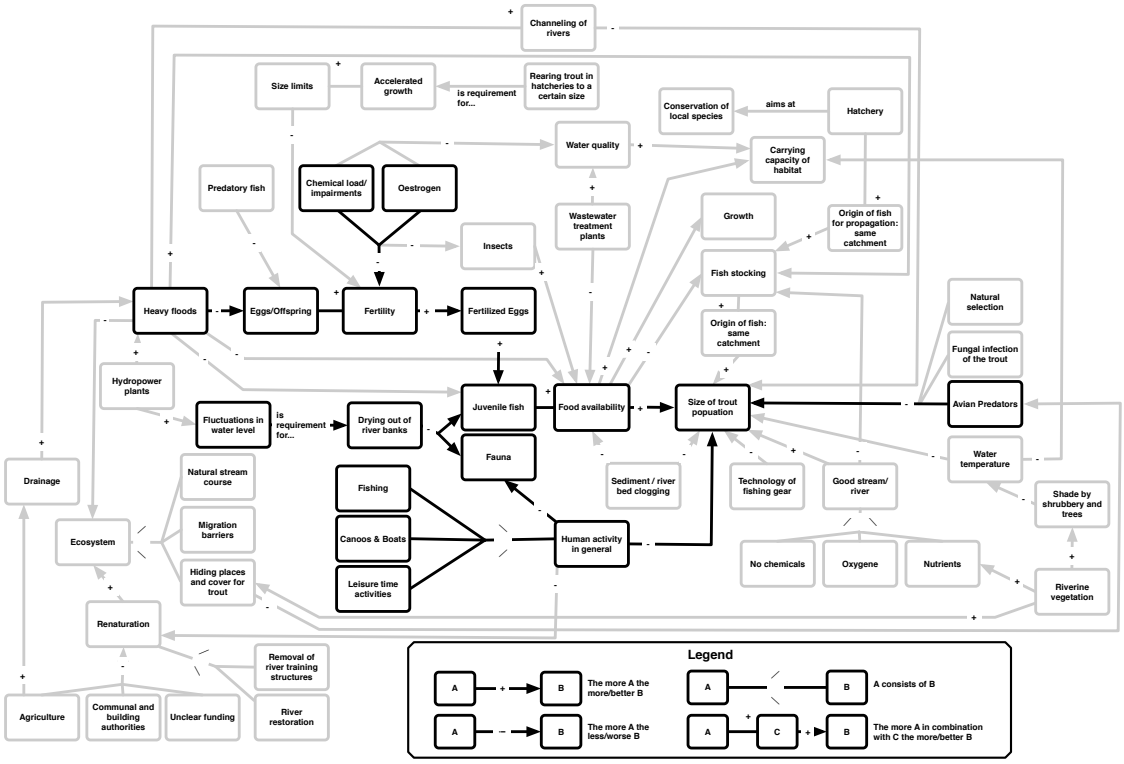

Figure 7. Example of a mental model resulting from the combination of the open-ended theme-focussed interview and the modified SLT. The black lines represent the structure laid by an interviewee during the SLT, while the grey lines display the added content by the partially transcribed open-ended theme-focussed interview.

In summary, it can be concluded that both the open-ended theme-focussed interviews according to Witzel (1985, 2000) and the modified SLT based on Scheele and Groeben (1988) provide a set of methods suitable for eliciting mental models.

III.3 Eliciting Mental Models with Quantitative Methods

In the second stage, a nationwide questionnaire study was designed, aiming at eliciting mental models on a larger scale. Thus, the most relevant findings from the qualitative approach in stage I should be validated by surveying a larger sample of anglers and further insights should be gained. The constructed questionnaire could be understood as a 'confirmatory questionnaire' in the sense of Morgan et al. (2002). Referencing to Norman's (1983) warning about eliciting mental models via questionnaires, and to Morgan et al.'s (2002) comments on biasing the target population by introducing new concepts to it, the construction of a mental models questionnaire required thorough pre-testing.

III.3.1 Questionnaire design and pre-tests

As shown above, eliciting mental models via the open-ended theme-focussed interview and the modified SLT is a combination of qualitative methods suitable for eliciting mental models. With the assumption that the qualitative principles of these methods worked, a questionnaire was designed that should be administered to a larger sample and elicits comparable mental models to those resulted from the qualitative approach. With this requirement, a total of four different versions were pre-tested. Figure 8 gives an overview about the different designs for eliciting mental models via questionnaires.

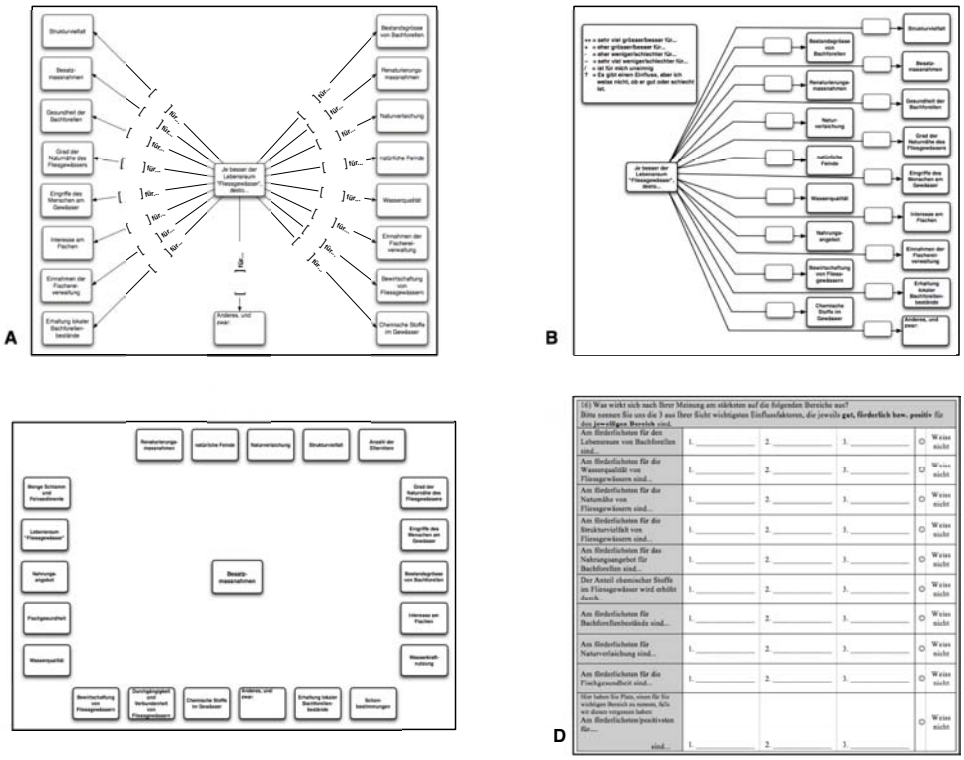

Figure 8. Different versions for eliciting mental models via questionnaires. Version A, B, and C resulted in confusion in the pre-testers, while version D was rated as clear and understandable, and generated reasonable results.

All version displayed in figure 8 were subject to pre-testing. For the pre-tests, four random samples of 20 persons each were drawn from a total of 1901 Swiss anglers using the open source software R's 'sample' function. A questionnaire, containing either version A, B, C, or D (see figure 8) for assessing the mental model, combined with appropriate pre-test instructions, was mailed to each person in the pre-test sample. Version A, B, and C were more visual orientated approaches, where the participants were instructed to either draw and define relations between given concepts (where one concept could be added by the participant) or where they should define given relations between concepts (version A and B). The feedback on version A, B, and C clearly indicated that these versions created confusion in the pre-test samples and lead to no reliable and analysable results, even though a detailed instruction was included. In contrast, version D relied on open-ended questions asking for the three most positive and negative aspects impacting key-concepts for stocking and processes in the stream and river ecosystem, and received positive feedback from the pre-testers. Furthermore, the results from version D were unambiguous and could be categorised easily. Thus, it can be concluded that open-ended questions with the restriction to only mention the most positive/negative impacts on diverse concepts worked best in the present study for eliciting mental models via questionnaires.

Because the questionnaire containing the above-presented mental models section (version D) was designed for a Swiss-wide survey study (stage II), it was also translated from its original language German into French, to cover a larger part of the Swiss angler population. For ensuring that all concepts have been appropriately translated, a back-translation was conducted by two bilingual anglers who volunteered (for general details on back-translation see e.g. Brislin, 1970 or Werner and Campbell, 1970). Additionally, an electronic version was uploaded to the project homepage and the link mailed to Swiss anglers' internet discussion groups.

In total, the final questionnaire was very long. It consisted of 23 Din-A4 pages, containing 200 closed and 37 open-ended items, and required one to two hours for completing it. Being much too long, time-consuming and complex, it was taken into account to receive a presumably low response rate. On the other hand, such a long questionnaire was needed to elicit to the qualitative mental models comparable results. The complete questionnaire can be found in the appendix, chapter XIV.2.1 (in German language only). We used the opportunity to provide participants with feedback on their 'type of angler' as an incentive to enhance the presumably low response rate. Details on defining the 'type of angler' and the complete feedback-report are provided in the appendix, chapter XIV.4 (in German language only.

III.4 Eliciting Stocking Success

The third and last stage was designed to conduct stocking success controls with participating fishing clubs, and to apply mental models derived intervention to initiate and promote adjusting stocking according to stocking success results. Referring to the implications of mental models theories for intervention planning (chapter II.3), participative stocking success controls seemed to be the method of choice.

The participative stocking success controls followed a mark and recapture design (Williams, Nichols, and Conroy, 2002), which in this case meant that the stocked trout have been marked before being stocked. Thus, they could be identified and discriminated in later recaptures from trout derived from natural reproduction (details are given in chapter VII). The stocking and marking processes were conducted under the supervision of a fisheries biologist and the anglers participated actively in the catching and stocking, and assisted in the marking of trout. Thus, stocking and marking trout was likely to become a meaningful action in the sense of Kaplan and Kaplan (2009) for the anglers.

Besides stocking and marking of trout, recurring recaptures were needed for assessing the stocking success. Therefore, the stocked rivers have been monitored by conducting electro-fishing, which is considered as one of the most common fish-catching methods for surveying and monitoring purposes (e.g. Hill, Fasham, Tucker, Shewry, and Shaw, 2005). Again, all fisheries-related activities in the frame of the present study were under supervision of a fisheries biologist, who was responsible for the biological aspects of this interdisciplinary research project.

Additionally to the ‘biological assessment of stocking success’ described above, the participating anglers’ assumptions and beliefs of stocking success were monitored using recurring surveys (for details regarding the monitoring design see Chapter VII, the questionnaires can be found in chapter XIV.3). By this, the anglers’ perceived stocking success could be elicited and the results from the biological stocking success controls could be utilised for intervention planning. For example, if the biological assessed stocking success was below an angler’s expectation, it should be usable for questioning the functionality of stocking in the angler’s mental model.

III.5 Samples

According to the study design reported in chapter III.1, a total of three samples were accessed in this research project. All samples consisted of anglers who either volunteered to participate in the interviews, responded to the Swiss-wide survey study, or belonged to one of the six fishing clubs that participated in the stocking success controls. Regarding Stage III, where participating fishing clubs were surveyed, there were a total of four measurements (one baseline survey, two short questionnaires and a last survey after the workshop at the project end; see chapter VII for details or for the questionnaires appendix XIV.3.1 Baseline questionnaire, XIV.3.2 Short questionnaire after interim report, XIV.3.3 Short questionnaire after final report and XIV.3.4 Short questionnaire after workshop). The present chapter will provide basic demographical sample statistics for each above-mentioned sample. Table 1 summarises the demographical statistics.

Table 1.
Basic demographical statistics for each sample (stage I, II, and III). In stage III were a total of four measurements conducted, which are presented seperatedly.

		Sex		Age in years		Fishing experience in years	
Sample	N	% male	Main language	Mean	SD	Mean	SD
Stage I	12	100	German	52.0	16.44	38.5	17.96
Stage II	418	96.4	German/ French	53.31	14.38	38.10	15.80
Stage III.1*	53	100	German	53.71	15.97	35.14	17.39
Stage III.2*	160	--	German	54.54	14.05	33.44	15.21
Stage III.3*	106	---	German	57.00	6.91	---	---
Stage III.4*	50	---	German	58.05	10.62	---	---

Note: * Due to poor quality of panel data, the demographics for each measurement are presented. See chapter VII for details on data processing for further analysis.

According to table 1, the samples in the different project stages did not differ in the mean age and mean fishing experience. All samples consisted of almost only male anglers and the mean age could be considered as relatively high, ranging from a mean of 52.0 to 58.05 years between the samples. Additionally, the surveyed anglers in each stage/sample were on average very experienced: the mean angling experience in years ranged from 33.44 to 38.5 between the samples.

The level of highest education was elicited for the samples in stage I and stage II. However, in stage III it was only assessed in the first survey. Figure 9 summarises the sample statistics regarding education for stage I, II and III.1.

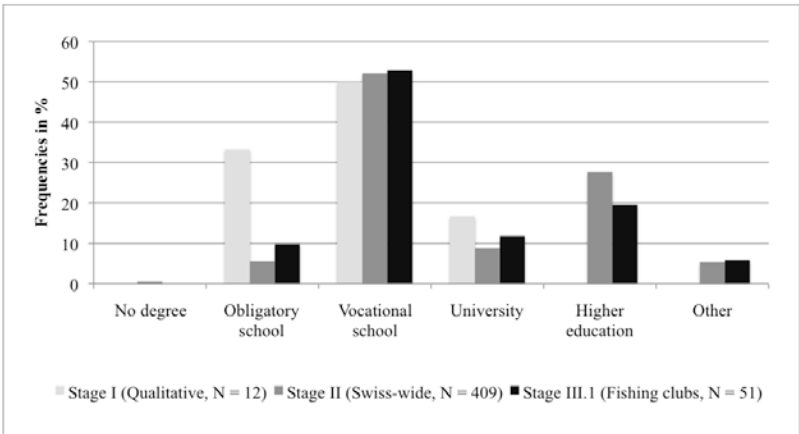

Figure 9. Highest level of education for the participants of each sample (stage I, II and III.1). The level of education was assessed only in the first measurement of the recurring surveys regarding stage III.

As can be seen in figure 9, the majority of each sample stated that they had vocational school as their highest education, followed by higher education in general for the Swiss-wide sample (stage II) and the members of the participating fishing-clubs in stage III. In the qualitative sample (stage I), the second most frequent answer was given for obligatory school. Only a minority had a university degree or finished his/her formal education after leaving obligatory school (except the qualitative sample, stage I).

Regarding the cantons where the anglers in each sample fish regularly, a diverse picture could be found (figure 19).

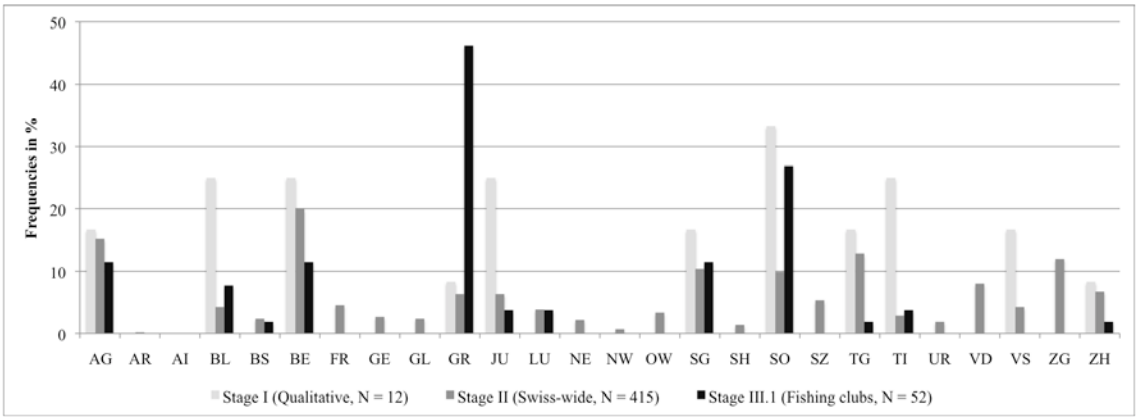

Figure 10. Spatial distribution of the surveyed anglers' fishing activities. The graphic shows how many anglers (in percent) of each sample fished regularly in which canton (multiple responses were possible).

According to figure 10, the sample of stage II (Swiss-wide survey) covered almost all Swiss cantons with their regularly fishing activity, while the sample in stage III concentrated on the cantons where the fishing clubs were located. For sample I it could be inferred that these anglers clearly preferred to fish in more than one canton regularly. On average, taking the multiple responses into account, the anglers belonging to the sample in stage I fished regularly in 2.25 cantons, while the surveyed anglers in stage II mentioned an average of 1.5 and the members of the fishing-clubs 1.32 cantons for regular fishing activity.

IV. The Relevance of Habitat and Fisheries Management for Brown Trout Stocks – an Anglers' Perspective[2]

Abstract

Anglers are important stakeholders for the management and the conservation of inland waters. To understand their knowledge and perception of running water ecosystems, the mental models of Swiss anglers were assessed through interviews and a nationwide survey, and compared to expert knowledge taken from the literature. The focus was on trout, trout habitat requirements and impairments as well as on stocking, a traditional yet controversial fisheries management tool. The anglers' mental models considered numerous factors that were highly interconnected and reflected major parts of the complexity of running water ecosystems. Deviations from expert knowledge were more pronounced with respect to stocking, which was attributed more potential and less risks by anglers. Two groups of anglers were identified: (i) About two-thirds of the anglers stated that stocking should be done independently of the natural reproduction of wild trout populations (additive type of mental model). (ii) One-third said that stocking should depend on the degree of natural reproduction (compensatory type of mental model). The latter statement can be considered more adequate and pro-environmental, and future education programs for anglers should specifically target this aspect. Mental models proved a valuable tool to better understand stakeholders and thereby to address the human dimension of natural resource management.

Keywords

angler survey, mental model, stakeholder analysis, stocking, habitat

[2] This chapter was designed as a stand-alone manuscript for publication in Fisheries Research, where it is currently under review. Authors: Susanne S. Haertel-Borer, Eike von Lindern.

IV.1 Introduction

Environmental problems are often complex, multi-scale and affect multiple actors (Reed, 2008). Stakeholder participation is increasingly used in environmental decision making and embedded in environmental policy (Reed, 2008; Reed et al., 2009). Methods for stakeholder analysis usually focus on identifying stakeholders, on differentiating between and categorizing them or on investigating relationships between them (for an overview see Reed et al., 2009). A deeper insight into the stakeholders' knowledge and perceptions might, however, be helpful and contribute to problem solving in many cases.

In aquatic resource management and conservation, both commercial and recreational fishermen (the later are hereafter called anglers) are important players. In industrialized countries, recreational fisheries often dominate the inland fisheries sector (Welcomme and Bartley, 1998; Arlinghaus et al., 2002) and anglers are the main stakeholders. They can be instrumental in fisheries conservation (Granek et al., 2008), but can also significantly impact ecosystems and biodiversity through exploitation and/or fisheries management (Cooke and Cowx, 2006; Lewin et al., 2006; Granek et al., 2008).

Stocking is one of the oldest, yet most controversial and least well-understood approaches to fisheries management (Lorenzen, 2005). It can be defined as the intentional release of large numbers of fish into a water body. Main motives are mitigation of human-caused habitat perturbations, restoration or conservation of stocks and harvest increase (Cowx, 1999; Arlinghaus et al., 2002; Holzer et al., 2003; Baer et al., 2007). Among anglers, stocking is widely popular due to its perceived simplicity and commonly regarded as being the ultimate and immediate solution to declining fishing quality (Molony et al., 2003) and to mitigate anthropogenic stress (Arlinghaus et al., 2002). Fisheries ecologists attribute to stocking the potential to threaten fish conservation and the sustainability of indigenous fish stocks and thus question its effectiveness (Lorenzen, 2005; Cooke and Cowx, 2006). These contrasting views illustrate that stocking and fisheries management in general have both ecological and social dimensions and that understanding the stakeholders' beliefs and perceptions is essential.

Switzerland is a good example to illustrate the controversy. Anglers are the sole fisheries users in running waters and fishing clubs actively participate in stocking and other management activities. Brown trout (*Salmo trutta fario*; hereafter trout) is their most important target species. Following a long tradition, on average 71 million trout fry equivalents (mainly released as fingerlings) were stocked annually between 2001 and 2006 in

Swiss running waters (FIBER, 2008). A survey revealed that the majority of the Swiss anglers advocate increased stocking (Schwärzel Klingenstein et al., 1999).

To obtain a comprehensive picture of stakeholders' beliefs, theories and perceptions about a system, eliciting mental models is an excellent approach. Mental models can be understood as subjective theories and functional models for any given system with which there is direct or indirect interaction (Norman, 1983; Johnson-Laird, 2006). Mental models provide individuals with general principles that help them judge and understand how things interact with each other (Morgan et al., 2002; Kaplan and Kaplan, 2009). They are created as soon as there is interaction with any system, and their constitution depends on the background knowledge possessed by the interacting person (Norman, 1983) and on individual experiences. Mental models represent states of affairs and give explanations about events happening in the world (Johnson-Laird, 2006). In our case they represent the angler's beliefs about and perception of trout, the relevance and impact of habitat parameters and of fisheries management. They lead to an attitude toward e.g. stocking as a management tool through anticipation of the impact of stocking. Eliciting mental models has been utilised in diverse research fields, e.g. in risk communication (Morgan et al., 2002), in human reasoning (Johnson-Laird, 2006), and in intervention design (Breakwell, 2001). Altogether, analysing mental models is a promising approach to learn and understand why people do what they do when managing the environment. This can then be used to mitigate management conflicts, target information and education campaigns and thus ultimately to promote pro-environmental management practices.

In this study, we compiled in a first step "expert (from research and management) knowledge" on trout, trout habitat requirements and on fisheries management (namely stocking) in general and on the situation in Switzerland in particular. In the second step, we assessed the anglers' mental models by a combination of interviews and a questionnaire survey. There, we specifically addressed the following questions:

- What do anglers think and believe about trout and their habitat requirements and impairments? What do they think and believe about fisheries management with a special focus on stocking?
- Are there different sub-groups within the angler population that differ significantly in their mental models with respect to stocking?

In the third step, the expert knowledge served as a benchmark in the discussion to rate the anglers' statements and to identify gaps between expert and stakeholder knowledge.

IV.2 Methods

IV.2.1 Compilation of "expert knowledge"

"Expert (research and management) knowledge" on trout, their habitat requirements and fisheries management, namely stocking, and on the situation in Switzerland, was taken from the literature, relying on publications listed in Web of Science® and, where necessary, on local, but web-accessible reports characterizing the situation in Switzerland.

IV.2.2 Assessment of anglers' mental models

To assess the anglers' mental models we first conducted an interview pre-study. Based on its results, we then designed a nationwide survey using identical paper-and-pencil and web based questionnaires.

IV.2.2.1 Interview pre-study

The interview study followed Witzel's open-ended theme-focussed interview technique (Witzel, 1985, 2000), a non-standardized method to gather qualitative data. It consisted of a short collection of socio-demographical data, followed by a narrative interview. The interview was combined with a modified version of the structure-laying technique (hereafter SLT; Scheele and Groeben, 1988). It was applied immediately after the interview as a schematic recapitulation and visualisation of the main topics that were mentioned during the interview. The participants were asked to write the main topics one by one on red cue cards, to describe the relations among topics on separate green cue cards and to lay out the respective interrelationships on a table. The resulting structures were photographed for later assessment. Both the interview and all conversation during the SLT were voice-recorded. The topics mentioned in the interview and their interrelations were assessed and linked to the results from the SLT. A combined schematic representation of each participant's mental model resulted. 12 anglers recruited at a fishing club meeting as well as through personal contacts were interviewed this way. Each interview took about 2 hours. The interview study is described in more detail in von Lindern et al. (submitted; chapter V. See also chapter III.2 and III.3 for details on the above-mentioned methods).

IV.2.2.2 Nationwide angler survey

Based on recurring structures and topics identified in the interviews, a questionnaire for the nation-wide angler survey was constructed. This collected mental models on a broader scale.

The first part of the questionnaire contained demographics and basic questions on the individual's fishing behaviour. The main part dealt with experiences with and perceptions of trout stocks, running water habitat parameters and fisheries management, and was used to elicit the mental models. It consisted of open-ended and closed questions. To capture the impact factors and interdependencies within the ecosystem, we constructed for each topic a positive ("Please write down the three most influential factors that have a positive/beneficial influence on...") and negative ("Please write down the three most influential factors that have a negative/damaging influence on...") questionnaire item. To not miss a vital part of the anglers' mental models, we provided an additional open question where the anglers were asked to write down a missing topic (if there was any) and the respective impact factors. This section was followed by a number of closed questions on various aspects of fisheries management and stocking. The final part of the questionnaire addressed the understandability of the questionnaire and provided an opportunity for feedback and criticism. In total, the questionnaire consisted of 200 closed and 37 open-ended items on 23 pages and its completion required 1 to 2 hours. The nationwide survey study was mailed to 3315 Swiss anglers. An electronic version was uploaded to the project homepage and the link mailed to Swiss anglers' internet discussion groups.

From the nation-wide survey, the mental models were constructed by categorising the most influential positive and negative impact factors. Due to the vast number of answers given, only those factors mentioned first and by at least 5 % of the surveyed anglers were included in the analysis (see IV.3.2).

IV.3 Results

IV.3.1 Expert knowledge

IV.3.1.1 Trout, trout habitat requirements and impairments

In Switzerland, 91 % of the running waters belong to the trout zone (Droz et al., 2006). Trout catches by anglers declined by 60 % since the early 1980s, which can be likely attributed to an actual decline of trout stocks (Burkhardt-Holm et al., 2005). Extinctions or population declines are usually the result of a variety of interacting biological and environmental factors (Allendorf, England, Luikart, Ritchie, and Ryman, 2008). For Switzerland, three key factors were identified in an earlier comprehensive nationwide study (Burkhardt-Holm et al., 2005): the habitat situation (morphology and water quality), fish health and fisheries management.

Trout have distinct habitat requirements, which make them susceptible to anthropogenic changes. As far as water quality is concerned, trout in general thrive in unpolluted, well oxygenated running waters (Elliott, 1994). In Switzerland, nutrient loads have been substantially reduced during the past decades (Burkhardt-Holm et al., 2005). Surface waters can, nevertheless, receive excess loads of nutrients (e.g. from stormwater overflows during heavy rainfalls) or, more recently, of synthetic chemicals (Burkhardt-Holm et al., 2005; Burkhardt-Holm et al., 2008; Gälli et al., 2009).

Brown trout are cold-water fish (Lessard and Hayes, 2003). Increased water temperature due to climate change (Hari et al., 2006) or stream regulation (Lessard and Hayes, 2003) has the potential to impact and restrict their thermal habitat. For Switzerland, Hari et al., (2006) found regionally coherent warming of rivers over the past 25 years resulting in an upward shift in suitable thermal habitat.

Habitat quality influences trout density and the maximum recruitment capacity is limited by the availability of habitat resources (Borsuk et al., 2006). Water depth, water velocity, stream bed substrata, and cover are the most important variables that influence habitat selection by brown trout (Heggenes, 1988; Elliott, 1994). Habitat requirements vary throughout the trout's life cycle, and natural river morphology characterized by habitat heterogeneity is therefore beneficial. Longitudinal and lateral connectivity within the stream and with the feeder streams is essential, as adult brown trout migrate upstream to spawn (Burkhardt-Holm et al., 2005). Trout are gravel spawners and for successful reproduction (spawning and egg development), suitable and well oxygenated sediments are essential (Elliott, 1994). In Switzerland, the morphology of running waters is severely impacted through river engineering, canalization and damming, and habitat fragmentation through migrations barriers like weirs and sills is high (Peter et al., 2005; Zeh Weissmann et al., 2009). Trout biomass in disconnected river stretches has been found to be distinctly lower than in reaches with good connectivity (Burkhardt-Holm et al., 2005). Hydropower production is intense, causing anthropogenically modified flow regimes and impacted bed load transport (Peter et al., 2005). Indications of increased erosion rates from land-use changes are evident and riverbed clogging was identified to contribute to the trout population declines in some river sites (Scheurer et al., 2009). Altogether, suboptimal habitat seems to be a strong causal factor for reduced trout populations in Switzerland (Borsuk et al., 2006).

Trout are opportunistic feeders (Crisp, 2000). Quantifying food supply in streams is a challenging task (Waters, 1988) and not very well studied in Switzerland. The available data do not indicate a decrease over the past decades (Fischnetz, 2004).

Impaired health can affect growth, survival and reproduction and thereby population size. Monitoring indicated an impaired health status of trout in Switzerland (Borsuk et al., 2006).
Avian predators and their impact on fish populations are a fiercely debated issue between fisheries stakeholders and conservationists (Behrens et al., 2008). In Switzerland, the populations of the three fish eating bird species great cormorant (*Phalacrocorax carbo*), common merganser (*Mergus merganser*) and grey heron (*Ardea cinerea*) increased along running waters in recent decades (Fischnetz+, 2007). A significant impact of cormorant predation is most evident for of grayling (*Thymallus thymallus*) populations and a national management plan for cormorant exists (Rippmann, Müller, Peter, and Staub, 2005).

IV.3.1.2 Fisheries management, namely stocking

Fisheries management aims at reducing overexploitation and at maintaining a suitable stock structure (Cooke and Cowx, 2006). Trout, popular with anglers, are widely managed through catch regulations and stocking. Stocking success depends on the local genotype-habitat interaction. It mainly contributes to anglers' harvest in cases where natural spawning is low or lacking, but where the habitat allows the growth of stocked fish (Lorenzen, 2005). Many studies have concluded that stocking is not a substitute for the control of fishing effort or habitat restoration (Molony et al., 2003).
Best practice for stocking is to use fish from supportive breeding that includes an adequate number of effective parents and fish that are reared under near-natural conditions (Holzer et al., 2003; Miller and Kapuscinski, 2003). In Switzerland, trout for stocking are produced under varying qualities of propagation programs and raised under different conditions. Most trout are stocked as young-of-the-year, aiming to compensate a real or perceived reproduction failure.
Among the risks associated with stocking are competition, predation, loss of genetic distinctiveness or the spread of diseases and parasites (Molony et al., 2003; Cooke and Cowx, 2006). For European trout, as for other geographically widespread species, local adaptation has been observed. Five major evolutionary lineages have been identified, that are all present in Switzerland (Bernatchez, 2001). In stocked populations, introgression ranging from near zero to almost complete displacement of wild populations have been found (Berrebi et al., 2000; Hansen, 2002; Hansen et al., 2009). In Switzerland, transfer of fish across major catchments as well as stocking of non-native species has been forbidden by law since 1993. Former stocking practices did, however, markedly impact populations structure (Largiadèr

and Hefti, 2002). Altogether, it can be assumed that maladjusted stocking practices might have contributed to the observed declines of trout catches (Fischnetz, 2004).

IV.3.2 Anglers' mental models

IV.3.2.1 Interview study

IV.3.2.1.1 Demographics and fishing background

The interviewees were between 24 and 80 years old (mean 52.0, SD 16.4). They all fish in running waters and can be considered as experienced, as they started fishing 11 to 74 years ago (mean angling experience in years: 38.5, SD 17.96).

IV.3.2.1.2 Perception and knowledge of trout, trout habitat and fisheries management

The analysis of the open-ended theme-focussed interviews in combination with the SLT revealed that all interviewees had a very detailed and complex mental model of running water ecosystems, trout, trout habitat and stocking. When the answers given were clustered and categorised to reconstruct the anglers' mental models on both an individual and an aggregated sample level, we identified 13 key-concepts that have a major impact from the interviewees' point of view. These concepts (following angler terminology as close as possible) were habitat, water quality, 'degree of naturalness' (in German: *Naturnähe*; a high degree of naturalness means a pristine river, in an almost undisturbed, natural state), river morphology, food availability, (chemical) impairments of the water quality, trout population size, natural reproduction of trout, fish health, stocking, conservation of local populations, predators and fisheries management. The concepts were highly interconnected (von Lindern et al., submitted, chapter V; cf. also Fig. 2 for results from the nationwide survey).

IV.3.2.1.3 Angler sub-groups

Regarding trout population size, natural reproduction and stocking, we found two different recurring structures (Figure 1a and 1b). Eight of the twelve interviewees stated that fish-stocking and natural reproduction affect trout population size in an independent and additive way (Figure 1a), and that stocking should therefore be conducted independent of natural reproduction. The other four interviewees linked the need for stocking to the degree of natural reproduction (Figure 1b). They saw stocking as a compensation for a lack of natural reproduction. We labelled the interviewees with the first model as additive-thinking anglers and the anglers with the second model as compensatory-thinking anglers.

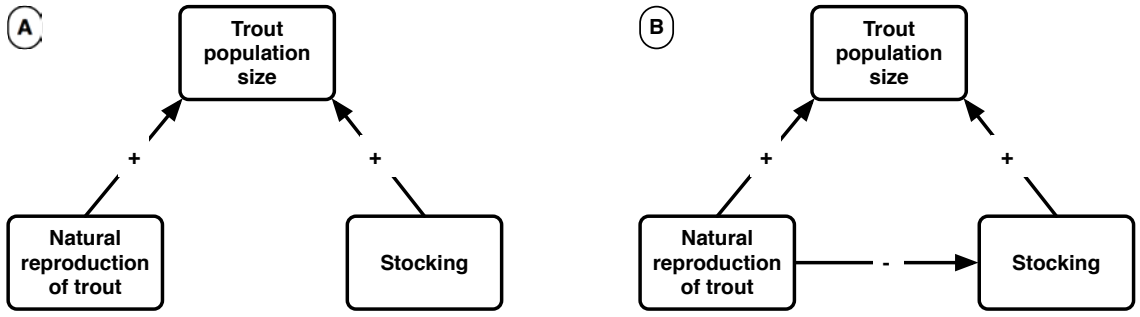

Figure 11 [Figure 1a and 1b of chapter IV]. **Figure 1a.** Additive model derived from the interviews. Stocking and natural reproduction affect the trout population in an independent and additive way (n = 8). **Figure 1b.** Compensatory model derived from the interviews. Stocking and natural reproduction affect the trout population interdependently. Stocking is only needed if natural reproduction is insufficient. The better the reproduction the less stocking is needed (n = 4).

IV.3.2.2 Nationwide survey

IV.3.2.2.1 Demographics and fishing background

Altogether, we received 418 completed questionnaires. The response rate, although not exactly determinable because of the internet version of the questionnaire, was below 15 %. Such a low rate was expected due to the length of the questionnaire. It was consciously accepted, as we needed such a comprehensive set of questions for assessing the mental model of our complex topic.

The participants in the nationwide survey were between 15 and 85 year old (mean 53.31, SD 14.38). The majority belonged to the age classes 50 – 59 (26.7 %) and 40 – 49 (23.8 %). 96.4 % were male and 1.4 % female (no data 2.2 %). Mean angling experience was 38.1 years (range 2 – 80, SD 15.8) and 83.5 % were members of a fishing organization. 91.9 % fished in brooks or small rivers (exclusively, often, sometimes or seldom) and 87.7 % in large rivers; they therefore had direct experience with water bodies inhabited by trout. The majority (65.8 %) fished regularly in 1 to 3 different water bodies. The median number of fishing days per year was 30 (range 0 - 280). Most participants had personal experience with fisheries management and stocked water bodies: they had participated in management activities (always, often, sometimes, or seldom) like fish stocking (79.9 %), electrofishing (67.7 %), raising of fish for stocking (49.7 %; some Swiss fishing clubs do own hatchery facilities) or spawning fisheries (44.1 %) and 91.6 % of the participants indicated that fish were stocked into the water body where they regularly fished.

About half of the participants believed that more than 50 % of the fish they catch go back to stocking (Table 1).

Table 2 [Table 1 of chapter IV].
Answer frequencies of anglers in the nationwide survey to the question 'Which percentage of the fishes that you catch, goes back to stocking?' (N = 418).

Fraction of caught fish that go back to stocking (%)	Answer frequency (%)
0 - 25	26.8
26 - 50	25.0
51 - 75	18.8
76 - 100	29.4

The majority (65.9 %) indicated that trout naturally reproduce in the stream they fish most often (26.2 % no natural reproduction; 7.9 % I don't know). Of those 65.9 %, only 19.1 % were of the opinion that the natural reproduction is sufficient to sustain the trout stock, while 74.9 % did consider it insufficient (6.0 % I don't know).

IV.3.2.2.2 Anglers' mental Models

For assessing the mental models, we categorized the total of 7843 answers given to the open-ended questions that concerned the 13 key-concepts into 43 categories. To reduce complexity when building the mental models, we took only categorized answers into account that were given by at least 5 % of the participants. With this setting, 21 categories influenced the anglers mental models beside the 13 key concepts (Fig. 2). The key concepts and categories were highly interconnected (Fig. 2).

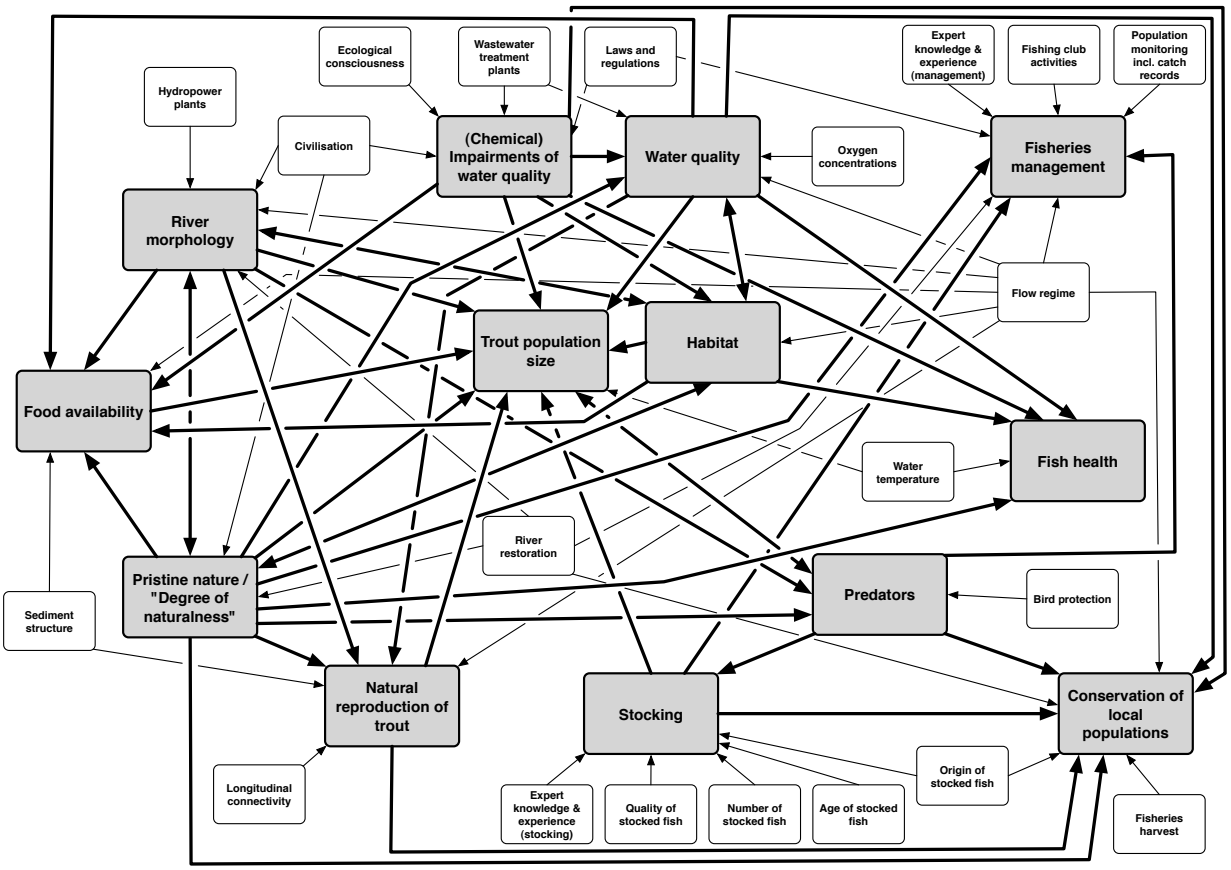

Figure 12 [Figure 2 of chapter IV]. Mental model of Swiss anglers of trout, trout habitat requirements and impairements and fisheries management (with a focus on stocking) derived from a nationwide survey.

In the next step, the causal directions of those interconnections and their frequency of mentioning were analyzed. Only frequencies ≥5 % were taken into account. The results are summarized in Table 2 (next page).

Table 3 [Table 2 of chapter IV].
Impact categories and the causal direction of their impact on the 13 key concepts in the anglers' mental models of trout, habitat requirements and impairments and of fisheries management (stocking) illustrated in figure 1. Percentages represent frequency of mentioning by the participants in the nationwide survey (N = 418).

Key concept	Strongest positive/beneficial impact category	%	Strongest negative/detrimental impact category	%
"degree of naturalness"	good habitat	23.6	proximity to civilisation	13.3
	well-done river restorations	9.7	bad habitat	5.8
	good river morphology	5.3		
	distance to civilisation	5.0		
habitat	good water quality	28.0	a low "degree of naturalness"	39.6
	high "degree of naturalness" = pristine nature	20.1	altered flow regime	9.5
	good river morphology	17.4	increased chemical impairments	8.9
			bad water quality	7.3
river morphology	high "degree of naturalness"	30.1	low "degree of naturalness"	47.0
	good habitat	9.2	proximity to civilization	6.7
	well-done river restoration	7.6	bad habitat	5.0
	natural flow regime	6.9	hydropower plants	5.0
water quality	reduced chemical impairments	23.2	increased chemical impairments	58.0
	waste water treatment plants	16.1	waste water treatment plants	10.2
	high "degree of naturalness"	10.8		
	good oxygen concentrations	7.1		
	natural flow regime	7.1		
	good habitat	5.3		
chemical impair-ments	waste water treatment plants	34.1	waste water treatment plants	16.9
	stricter laws and regulations	7.3	proximity to civilization	8.0
	increased ecological consciousness	7.0		
food avail-ability	good habitat	18.3	bad water quality	14.9
	good water quality	17.1	chemical impairments	14.5
	high "degree of naturalness" = pristine nature	16.8	a low "degree of naturalness"	13.5
	good river morphology	7.5	unfavorable sediment structure	10.5
	good sediment structure	7.1	bad habitat	7.9
			altered flow regime	5.8
trout stock size	good water quality	11.4	predators	14.0
	good river morphology	10.8	high water temperature	10.1
	high "degree of naturalness" = pristine nature	10.5	chemical impairments	9.4
	abundant food availability	8.6	bad water quality	8.8
	natural reproduction	8.0	low "degree of naturalness"	6.8
	stocking	7.6	bad river morphology	5.5
	good habitat	5.2		
	low water temperature	5.2		
natural re-production of trout	good sediment structure	39.3	unfavorable sediment structure	33.7
	good river morphology	11.1	a low "degree of naturalness"	17.6
	good water quality	10.2	altered flow regime	7.2
	high "degree of naturalness" = pristine nature	9.3	bad river morphology	5.2
	longitudinal connectivity	5.9		
fish health	good water quality	46.3	increased chemical impairments	30.4
	low water temperature	9.0	bad water quality	19.1
	decreased chemical impairments	6.5	high water temperature	11.4
	high "degree of naturalness" = pristine nature	5.3	bad habitat	5.0
con-servation of local po-pulations	successful natural reproduction	12.8	low "degree of naturalness"	12.6
	high "degree of naturalness" = pristine nature	9.8	origin of stocked fish: from another river basin	10.5
	good water quality	8.5	increased fisheries harvest	8.8
	(well-done) river restoration	8.5	increased chemical impairments	8.5
	stocking (in general)	6.6	altered flow regime	6.8
	origin of stocked fish: from same river basin	6.9	predators	5.4
man-agement	stocking	11.6	low "degree of naturalness"	15.4
	(well-done) river restoration	10.1	lack of expert knowledge and experience	8.1
	fishing club activities	8.2	altered flow regime	6.5
	expert knowledge and experience	7.9	predators	5.4
	population monitoring incl. catch records	6.4	lack of management	5.4
			laws and regulations	5.4
stocking	expert knowledge and experience	10.7	lack of expert knowledge and experience	10.0
	origin of stocked fish: from same river basin	8.0	predators	8.8
	stocking of juvenile fish	5.3	origin of stocked fish: from another river basin	7.1
	good quality of stocked fish	5.0	stocking as many fish as possible	5.0
pre-dators*	strict laws and regulations for bird protection	33.3	relaxing laws and regulations for bird protection	39.4
	low "degree of naturalness"	12.0	pristine nature	6.9
	big trout populations	7.6	good river morphology	5.4

***** When asked about **predators**, the participants thought mainly of the avian predators cormorant, merganser and grey heron, but also mentioned the human predator, angler.

IV.3.2.2.3 Perception of and knowledge on trout, trout habitat requirements and impairments

Five out of the 13 key concepts dealt with habitat parameters and covered both water quality and structural complexity (Fig.2). Both aspects were further specified through the categories, where oxygen concentrations, water temperature, longitudinal connectivity, sediment structure and flow regime arose as important habitat parameters and river restoration, waste water treatment plants, hydropower plants and proximity/distance to civilization as impact factors. The respective interdependencies are given in Table 2.

IV.3.2.2.4 Perception of and knowledge on fisheries management, namely stocking

Among the 13 key concepts in the mental models, fisheries management, stocking, conservation of local populations and predators referred to management issues (Fig. 2). Within the categories, expert knowledge and experience, population monitoring (including catch records), fishing club activities and various aspects concerning the stocked fish (quality, numbers, age, origin) were highlighted (Fig. 2). The respective interdependencies are given in Table 2.

Beside the open questions used to construct the anglers' mental models, various aspects of fisheries management and stocking were elucidated in more detail through closed questions.

According to the participants, management of trout streams should mainly aim at maintaining healthy fish populations and conserving local fish species and the flora and fauna (Table 3).

Table 4 [Table 3 of chapter IV].
Answer frequencies of anglers in the nationwide survey to the closed question 'Fish stocking should aim at…' (N = 407, multiple responses allowed).

Answer options	%
healthy fish population	94.1
conservation of local fish species	83.3
conservation of flora & fauna	81.1
increase of biodiversity	42.5
attractiveness for anglers	28.0
large fish population	12.3
other	12.3
income for management agency	6.9
don't know	1.0

Among different fisheries management tools, stocking was considered to be most influential on trout stock size, followed by size limits, closed seasons and areas and bag limits. Little power was attributed to fishing bans or limiting effort (Fig. 3).

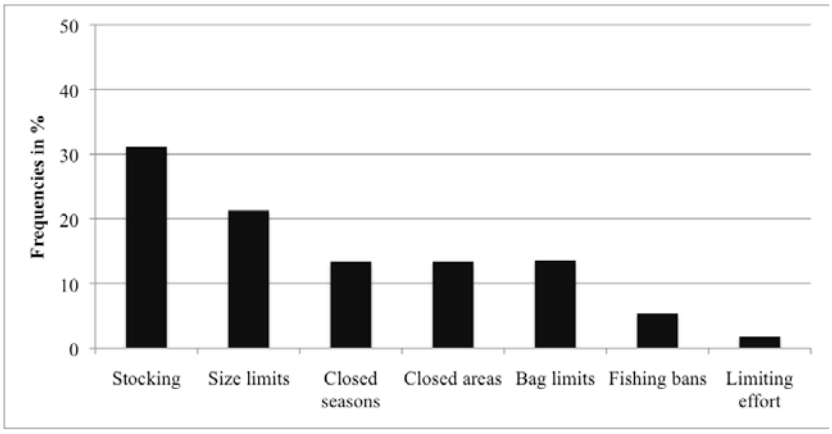

Figure 13 [Figure 3 of chapter IV]. Answer frequency of anglers in the nationwide survey to the closed question 'Which management tool is most powerful for increasing the size of brown trout stock?' (N = 389).

Among different motives for stocking, compensation of insufficient natural reproduction and of high losses through predators were considered most important (Table 4).

Table 5 [Table 4 of chapter IV].
Answer frequency of anglers in the nationwide survey to the closed question 'Which are the main motives for stocking?' (N = 285, multiple responses allowed).

Motive	%
compensation of insufficient natural reproduction	87.0
compensation of predation losses	58.2
compensation for fisheries harvest	44.6
balancing natural fluctuations in population size	39.3
having more fish for anglers	36.8
complying with the motto 'Who wants to harvest has to seed first'	26.0
being able to catch trout in all running waters	23.5
other reasons	16.8

When asked, whether nowadays it is feasible to stop stocking and to nevertheless fish successfully, two third (76.6 %) indicated "rather not" or "not at all". Only 21.7 % felt that this could work, while 1.7 % did not know. However, 71.2 % of the participants considered stopping stocking as a desirable long term goal of fisheries management. 23.8 % negated this statement and 5.0 % did not know.

Of the participants, 68.6 % agreed, that only a limited number of brown trout can live in any given stream (i.e. they did agree that there is a carrying capacity), 13.6 % were indecisive and answered partially agree or partially disagree, 17.8 % rather or fully disagreed.

The majority (72.7 %) of the participants indicated that the guiding principle for the planning of stocking should be "as little as possible", while 18.2 % said it should be "as much as possible". 5.3 % suggested abandoning stocking and 3.8 % did not know. The large majority

(90.5 %) fully or rather agreed, that the number of stocked fish should depend on the extent of available habitat; 6.0 % were indifferent and only 3.5 % fully or rather disagreed. About half of the participants (45.8 %) fully or rather agreed that stocking of juvenile fish can artificially increase trout stocks, no matter how many trout naturally live in that stream. 24.3 % marked "partly agree/disagree" and 29.9 % fully or rather disagreed.

Stocking with juvenile fish was considered most useful in cases of a lack or bad quality of spawning site, high losses through predators and after fish kills (Table 5).

Table 6 [Table 5 of chapter IV].
Answer frequency of anglers in the nationwide survey to the closed question 'When is stocking with juvenile fish most appropriate?' (N = 402, multiple responses allowed).

Situation in stocked water body	%
lack of or bad quality of spawning sites	81.1
high loss through predation	62.9
low population size after fish kills	50.5
bad habitat	29.4
chemical impairments of water quality	27.9
increased water temperature	26.6
high loss through fisheries harvest	25.6
bad water quality	25.4
high mortality through disease	22.1
low food availability	18.7
other reasons	5.2
stocking with juvenile is never good	3.5

A number of questions focused on what should be stocked. While the majority of surveyed anglers were of the opinion that stocking of adult trout should be rather or markedly decreased, most felt that stocking with egg and fry or fingerlings should be rather or markedly increased (Fig. 4).

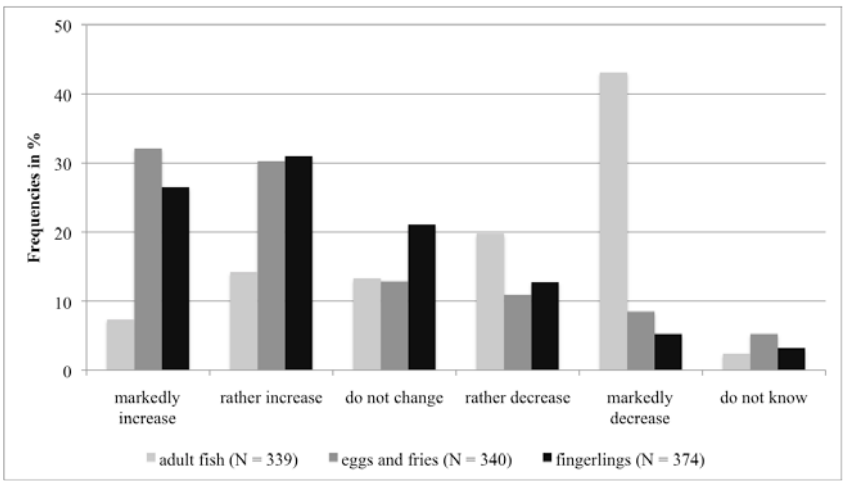

Figure 14 [Figure 4 of chapter IV]. Answer frequency of anglers in the nationwide survey to the closed question 'Which management tool is most powerful for increasing the size of brown trout stock?'.

More than half of the participants considered descendants of local parents annually caught from the same water body as ideal for stocking (61.8 %). The second choice was captive broodstock originating from local, wild fish (24.0 %). 7.2 % preferred parents of long-term, supra-regional broodstocks and 2.5 % felt that the origin of stocked fish did not matter. 1.1 % preferred a different origin or did not know (3.3 %). The majority of the angler sample (64.9 %) did not consider it wise to exchange fish between catchments through stocking; 29.8 % were in favour of it and 5.2 % did not know. The majority of participants were of the opinion that stocking non-native species should not be allowed (62.6 %), 24.2 % were in favour of it and 13.1 % were indifferent. Are there dangers associated with stocking? As worst-case scenarios concerning the outcome of stocking, the transmission of diseases and a lack of success were considered. 16 % felt that stocking is always positive (Table 6)

Table 7 [Table 6 of chapter IV].
Answer frequency of anglers in the nationwide survey to the closed question 'In the worst case, stocking – according to my opinion – can…' (N = 404, multiple responses allowed).

Effect	%
transmit diseases	61.1
lack success	49.5
lead to hybridization between stocked and local trout	42.8
increase the number of predators	37.9
induce competition within trout stocks	37.1
induce competition between trout and other fish	24.8
stocking is always positive	16.1
do not know	2.2

IV.3.2.2.5 Angler sub-groups

To check, whether the two sub-groups of anglers with respect to stocking (additive- and compensatory-thinking anglers) identified in the interviews, could also be found in the nationwide sample, we implemented in the questionnaire the statement "Fish stocking should be done independently from the degree of natural reproduction" (cf. Fig. 1 a and b). The 5-point answer scale ranged from "I totally agree" to "I totally disagree". Those 52.4 % of the anglers that rather or totally agreed, were treated as "additively thinking" for the further analysis and the 28.9 % that rather or fully disagreed as "compensatorily thinking"; 18.7 % were indifferent.

We then analyzed the interrelationships between the key concepts 'trout population size', 'natural reproduction' and 'stocking' for the additive and compensatory subgroups and the results were comparable to the interviews. (Figure 5 a and b).

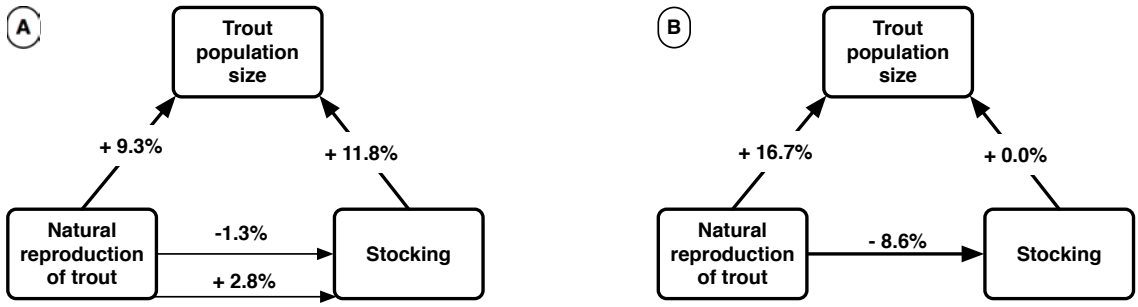

Figure 15 [Figure 5a and 5b of chapter IV]. **Figure 5a.** Additive mental model derived from the Swiss-wide survey. Stocking and natural reproduction affect the population in an independent and additive way (N = 207). **Figure 5b.** Compensatory model derived from the Swiss-wide survey. Stocking is needed where natural reproduction is not sufficient. The better the reproduction the less stocking is needed (N = 114). The percentages indicate the fraction of anglers who stated that the key-concept where the arrow points at was influenced most by the key-concept at the base of the arrow. A '+' means a positive impact, a '-' a negative impact.

In the additive subgroup, 9.3 % stated that natural reproduction has the strongest impact on trout population size, while 11.8 % considered stocking as most important. Interestingly, 1.3 % mentioned that stocking is hindered by the degree of natural reproduction and 2.8 % said that stocking should only be done if the natural reproduction is successful. In the compensatory subgroup, 16.7 % consider natural reproduction as the strongest impact factor for trout population size, while none of them mentioned stocking as most decisive; 8.6 % stated that a lack of natural reproduction has the strongest positive impact on stocking.

IV.4 Discussion

One main goal of our study was to assess the anglers' perception of and beliefs about trout, trout habitat and fisheries management and to compare it to expert knowledge. In an earlier comprehensive nationwide study on trout populations in Switzerland (Burkhardt-Holm et al., 2005), three key factors were identified as problematic: habitat (morphology and water quality), fish health and fisheries management. All of them were also highlighted by the anglers.

IV.4.1 Anglers perception of and beliefs about trout and trout habitat compared to expert knowledge

Five out of 13 key-concepts identified in our interviews with anglers dealt with various habitat parameters and covered both water quality and habitat structure. They were further detailed in the categories derived from the questionnaire survey. The anglers turned out to be well aware of the importance of habitat and the numerous anthropogenic pressures. As far as water quality is concerned, "chemical impairments" were emphasized beside mentioning "water quality" in general. This might reflect current public discussions of and studies on the role of micropollutants (Burkhardt-Holm et al., 2008; Gälli et al., 2009). With respect to waste water treatment plants (WWTP), it has become obvious that the anglers see their two-edged role and mention them as both positive and negative impact factors. On the one side, expanding and upgrading WWTPs in Switzerland has substantially reduced nutrients loads in the past decades. On the other hand, WWTPs can still have negative impacts on streams in cases where the fraction of treated wastewater is high or through stormwater overflows during heavy rainfalls (Burkhardt-Holm et al., 2005). The elimination of micropollutants has just begun (Gälli et al., 2009). Water temperature was stressed as an impact factor, without explicitly mentioning the term "climate change". Morphological aspects and flow conditions played a decisive role for the anglers and were expressed in key concepts and categories like morphology, connectivity, sediment structure, flow regime or hydropower plants. This reflects very well the precarious situation of Swiss running waters (Burkhardt-Holm et al., 2005; Peter et al., 2005; Zeh Weissmann et al., 2009).

Two topics very relevant for the anglers were "food availability" and "avian predators". It became obvious that they believe that pristine streams with good habitat in terms of river morphology, water quality and sediment structure provide abundant food, which in turn is beneficial for trout population size. While the mental model of the anglers is fairly detailed with respect to food availability, the expert knowledge does not provide much quantitative

information. This is similar for “avian predators”, which is an important item for anglers with respect to trout population size, conservation of local populations, river/fisheries management and stocking.

IV.4.2 Anglers perception of and beliefs about fisheries management, namely stocking

Fisheries management was among the three main problems identified for trout populations in Switzerland in the nationwide trout study and there is indication that maladjusted stocking practices (with respect to number and age of the fish stocked, genetics, etc.) could have contributed to the observed declines in trout populations (Fischnetz, 2004; Burkhardt-Holm et al., 2005). When asked about the most powerful fisheries management tool, the anglers considered stocking most powerful, followed by size limits and closed seasons and areas. Least power was given to fishing bans and limiting effort. This is in accordance with Arlinghaus and Mehner (2005) who found that anglers on average oppose management strategies that potentially restrict their own activity. While abandoning stocking was considered a desirable long term management goal, the majority of anglers indicated that this is currently not feasible. Compensating for insufficient natural reproduction was by far considered the most important motive for stocking. This is also a well accepted motive in modern stocking guidelines (Arlinghaus et al., 2002; Baer et al., 2007). Compensation of losses through predators ranked second. In accordance with guidelines, stocking juvenile fish was mainly considered appropriate when spawning sites lack or are of bad quality. High losses to predators were again mentioned second. Altogether, the anglers attribute much power to stocking. They mentioned some circumstances, where stocking can be useful and in accordance with modern stocking guidelines. They, however, also attribute power that stocking does not have, namely in the field of compensating losses due to avian predators.

From the mental models it became obvious, that anglers pay much attention to the fish stocked, in terms of quality, age, origin and number. When asked in more detail, what fish of which origin and age, should be stocked, the anglers clearly voted for descendants of local parents. The majority indicated that stocking with juvenile fish (eggs, fry and fingerling) should be increased while stocking with adults in catchable size should be decreased. The majority also stated that stocking non native species should not be allowed. This is a considerable change in attitude concerning adult stocking and non native species (rainbow trout, *Oncorhynchus mykiss*) compared to a study conducted by Schwärzel Klingenstein et al. (1999), where the anglers interviewed felt, that stocking of all age classes should be

increased. This change, along with the consciousness for conserving local populations might mark a beginning shift in stocking attitudes of Swiss anglers towards increased sustainability.
When asked about the dangers associated with stocking, spreading diseases, being unsuccessful, increasing the number of predators and potential crossings between wild and stocked fish were considered most relevant. Only a minority indicated, that stocking is always positive. Disease outbreaks are certainly the negative consequences of stocking most visible to anglers. With respect to predators, the anglers were somewhat ambiguous. On the one hand, stocking is considered powerful to compensate for predation loss, on the other hand, it seems to augment the predator problem by feeding them.
The conservation of local populations turned out to be an issue for the anglers in the interviews. In the nationwide survey, a number of positive and negative factors for conservation were listed. Again habitat parameters ranked high in both categories. Natural reproduction was given the most positive credit; however, stocking and the origin of stocked fish together ranked equally high. On the negative side, anglers considered non-local origin of stocked material along with non-pristine nature most important. So altogether, there is a strong belief in stocking and some unrealistic potential is attributed it. There was, however, a marked change concerning the attitude towards stocking, adult fish and non-native species (compared to Schwärzel Klingenstein et al., 1999) and the awareness for the conservation of local populations.
Concerning stocking numbers, there were some contradictions in the survey results. On the one side, a majority of anglers said that only a limited number of trout can live in any given stream, that the number of stocked fish should depend on the extent of available habitat and that the basic guideline for stocking should be “as little as possible”. All these statements point to the acceptance of a habitat carrying capacity. On the other side, a majority indicated that stocking should take place independently of the natural reproduction in a stream. Answers were mixed with respect to the question whether stocking with juvenile fish can artificially increase trout stocks, no matter how many fish naturally live there.

IV.4.3 Angler sub-groups

From recreational fisheries research it is well known, that anglers usually do not form a homogenous group but can be distinguished with respect to e.g. consumptive orientation (Kyle et al., 2007) or fishing preferences (Connelly et al., 2001). Different sub-groups with respect to stocking attitudes were therefore expected to be likely and help to resolve the contradictions observed concerning stocking amounts. In both the interviews and the Swiss

wide survey, we identified an additive- and a compensatory-thinking sub-group of anglers. The larger, additive sub-group believes that stocking and natural reproduction affect trout population size in an independent and additive way, and that stocking should therefore be conducted independently of natural reproduction. The smaller compensatory sub-group links the need for stocking to the degree of natural reproduction. Only compensatory-thinking anglers seem to accept that each stream does have a carrying capacity and that stocking cannot increase this capacity. The differentiation first observed in the interviews could be reproduced in the nationwide survey and these differences have a distinct impact on diverse fishing related topics, ranging from the understanding of and functional theories about running waters and brown trout population dynamics to attitudes towards and preferences for different management tools. As a conclusion we hypothesize that the more an angler disagrees with the statement that fish stocking should be done independently from the degree of natural reproduction the more likely he or she thinks and acts in a pro-environmental way. This issue will be addressed in our future research. Future information and education of anglers on stocking should specifically address this point and strive to change additive to compensatory attitudes. Moreover the potential and limits of stocking and the carrying capacity concept should be more clearly communicated.

IV.4.4 Mental models and stakeholder analysis concluded

To assess the mental models in the nationwide survey, we used a questionnaire, which was long and demanding to fill in. This was, however, necessary, to get a comprehensive picture of our complex topic. As a consequence, mainly dedicated and motivated anglers might have participated in the survey and might have biased the mental models towards above-average complexity and ecosystem understanding. But those anglers are usually also the ones who actively participate in decision-making in their clubs, interact with authorities and scientists and are willing to participate in education programs, to later serve as multipliers of information and knowledge.

In the open-ended questions, some of the impact factors (categories) were only mentioned by a relatively low percentage of the participants. This can be explained by the variety of competing factors. The participants were only allowed to mention the three most important positive and negative impact factors on a certain key concept and were therefore forced to decide on these even if they thought that there were several competing ones. This ensured, however, that they actually focused on what they consider most important.

Methods for stakeholder analysis are usually restricted to the identification of stakeholders, to differentiating between and categorizing stakeholders or to investigating relationships between them (Reeds et al. 2009). We went one step further and assessed mental models of ecosystem functioning and management in order to better understand the stakeholders' knowledge, perception and attitudes. This proved to be a powerful tool for identifying factors relevant from the stakeholders' point of view and for analyzing interrelations among those factors. It was possible to get a comprehensive picture of their very own ideas and subjective theories about ecosystem processes. This knowledge can be used to specifically target environmental education programs towards stakeholders' misconceptions. Practical stakeholder knowledge can, however, also be used to enhance, motivate or content-validate scientific theories and models.

We focused on anglers, an essential interest group in the management and conservation of inland waters. We chose running waters, trout and the management tool "stocking" as model systems. While fisheries ecologists increasingly consider stocking as a potential threat to local fish populations (Lorenzen, 2005; Cooke and Cowx, 2006), anglers favour it as a pancea (Arlinghaus et al., 2002; Molony et al., 2003). The anglers' mental models resulting from both interviews with single anglers and a nationwide survey were complex, listed a considerable number of factors and showed a high degree of interconnectedness and numerous interdependencies. The observed complexity of the anglers` perception reflects major parts of the complexity of running water ecosystems. We, however, also identified some misconception concerning the mechanistic effect of stocking in parts of the angler population, the additive-thinking sub-group.

Altogether, the stocking discussion illustrates that natural resource management usually has both a biological and human dimension. Interdisciplinary research and management as well as a more profound understanding of stakeholders are needed to fully resolve management controversies.

V. How do Stakeholder's Mental Models Impact Ecosystem Management Preferences?[3]

Abstract

Stakeholders are often involved in decision-making processes in environmental management, and their beliefs about ecosystem processes are important to implement management strategies successfully. Using a preliminary qualitative study and a quantitative follow-up survey, we assessed the mental models of Swiss recreational fishermen (also called 'anglers') regarding their understanding of fisheries management, trout habitat requirements and population dynamics. As main results, we found that two-thirds of the surveyed anglers mentioned that fish stocking (i.e., the release of large numbers of propagated fish into water bodies with the intention of increasing fish population sizes) should be done independently of the natural reproduction of wild fish populations (additive type of mental model), and one-third of the anglers stated that stocking should depend on the degree of natural reproduction (compensatory type of mental model). We found significant differences in favour of the compensatory-thinking anglers regarding attitude toward stocking, preference for management tools and pro-ecological orientation. We concluded that eliciting mental models provides a more comprehensive picture of how people understand complex systems like aquatic ecosystems. Thus, the analysis of mental models provides a good starting point for planning interventions in the framework of environmental management.

Keywords: fishery management, mental model, management preference, fish stocking

[3] This chapter was designed as a stand-alone manuscript for publication in the Journal of Environmental Management, where it is currently under review. Authors: Eike von Lindern, Susanne Haertel-Borer, Hans-Joachim Mosler.

V.1 Introduction

Environmental and ecosystem management has long been accepted as relevant (and necessary) to human society as well as to conservation and sustainability matters (e.g., Jager and Mosler, 2007; Morrison, 2002). The relevance of environmental management has increased since it gained entry into politics and society (Beierle, 2002). As researchers have recognized the important role stakeholders play in practical ecosystem management, stakeholders have become increasingly involved in scientific environmental management research (Beierle, 2002). The management of recreational fisheries provides an excellent example for studying stakeholder involvement and their understanding of complex ecosystem processes. Welcomme and Bartley (1998) have reported the extent to which the involvement of recreational fishermen in management activities impacts fisheries management. Recreational fishermen (hereafter called anglers) are amongst the key players in fisheries management as, in Central Europe, they are often users and managers at the same time (Arlinghaus and Mehner, 2005). However, environments and ecosystems do not always benefit from stakeholder activities. As identified by Cooke and Cowx (2006) and Lewin et al. (2006), recreational fishermen have the potential to threaten fish populations through fishing and fishery-related management activities.

V.1.1 The decline of fish catches and management countermeasures

The decline in inland fish catches has become a topical issue in many countries (Burkhardt-Holm et al., 2005; Welcomme and Bartley, 1998). In Switzerland, streams and rivers are solely fished by anglers, and catches of the main target species, brown trout (*Salmo trutta fario*; hereafter called trout), have declined by 60% since the 1980s (Burkhardt-Holm et al., 2005). Fisheries management, impaired habitat and fish health have been identified as key factors responsible for this decline in trout catches in recent decades (Burkhardt-Holm et al., 2005).

One of the most widespread fisheries management tools is fish stocking (Cooke and Cowx, 2006), which can be defined as the intentional release of large numbers of fish into a water body. Fish for stocking are usually derived from parents caught from the wild or held in hatcheries; the offspring is reared to a certain age in hatcheries or (semi-) natural rearing streams or ponds. Stocking is popular among anglers and commonly regarded as the ultimate and immediate solution to declining fishing quality (Molony et al., 2003). The main motives for stocking are mitigation (to compensate for human-caused habitat perturbations, e.g., lack of spawning habitats), restoration (for stock recovery after fish kills or habitat improvements),

conservation (to retain populations of a species threatened by extinction) or enhancement (to increase harvest by stocking with adult fish or non-native species; Cowx, 1999) (Arlinghaus et al., 2002; Holzer et al., 2003).

Stocking statistics are remarkable. An estimated 40 billion fish are stocked annually in European fresh waters, and stocking to a similar scale is common around the world (Cooke and Cowx, 2006). In Switzerland, nearly 660 million fish were stocked in 2004 (FOEN, 2006). Mainly juvenile, young-of-the year trout were stocked in running waters to compensate for a real or perceived failure of natural reproduction. Stocking success (in terms of the contribution of stocked fish to fish populations and the angler catch) strongly depends on the quality and carrying capacity of the receiving habitat, the (reproductive) state of the local wild stock and the quality of the stocked fish (age, health status, genetic distance from local wild populations; Holzer et al., 2003).

In the past, stocking has generally been pursued uncritically, either with little scientific evaluation of its success or failure (Cowx and Gerdeaux, 2004; Welcomme and Bartley, 1998) or in spite of proven failure (Cowx, 1999; Lewin et al., 2006). More recently, a growing number of scientists and fisheries managers have come to consider stocking to be a threat to fish conservation and the sustainability of indigenous fish populations. They believe stocking has the potential to harm native populations through competition, predation, loss of genetic distinctiveness or the spread of diseases and parasites (Cooke and Cowx, 2006). Moreover, there are good indications that anglers overestimate the benefit of stocking streams (Burkhardt-Holm et al., 2005).

Evidently, stocking is not the most pro-environmental way to manage running waters. Thus, the question arises as to why anglers favour and attribute so much power to stocking (for Switzerland see Schwärzel-Klingenstein et al., 1999). To address this issue, it is necessary to assess anglers' mental models of stream and river ecosystem functioning and fish population dynamics, as well as their understanding of stocking.

V.1.2 About mental models

Mental models are an excellent approach to obtaining a comprehensive picture of stakeholders', in our case anglers' beliefs and subjective theories about processes in the aquatic ecosystem. Mental models represent states of affairs and give explanations about events happening in the world (Johnson-Laird, 2006). Markman and Gentner (2001) pointed out that mental models could be understood as a knowledge structure of the long-term memory. According to Norman (1983), mental models represent the systems (e.g., the aquatic ecosystem) with which humans are interacting, as well as beliefs about this system. Mental

models are build and maintained through the interaction and gaining of experience with the system (Norman, 1983). Mental models are created as soon as there is interaction with any system, and their constitution depends on the background knowledge possessed by the interacting person (Norman, 1983). Norman (1983) also stated that functionality is a necessary requirement of a mental model. The person interacting with the system permanently evaluates his or her mental model, and it will be revised if it is no longer functional for a certain purpose (Norman, 1983). Morgan et al. (2002) concluded that mental models are not models in a formal sense but provide individuals with general principles that help them judge and understand how things interact with each other. Kaplan and Kaplan (2009) emphasised the role of mental models in their Reasonable Person Model, stating that building a mental model about an environment is needed for information processing and for people to understand the environment. Further, they point out that the mental model-building process is essential, since people 'rely on them [mental models] for everything they do' (Kaplan and Kaplan, 2009, p. 330). According to Kolkman et al. (2005), mental models determine what information humans perceive from the real world and how this knowledge is processed for decision-making. Thus, the analysis of mental models is a promising approach to learning and understanding why people do what they do when managing the environment. Nevertheless, eliciting mental models remains a research challenge. As discussed by Norman (1983), it is unclear what is produced by the assessment of mental models in itself: the respondent's mental models about the topic/system under investigation or an *ad hoc* mental model about answering the specific question.

In our study, anglers' mental models about stream and river ecosystems can be understood as relatively stable structures given their frequent interaction with fishery-related actions. They represent the anglers' knowledge and beliefs about the ecosystem as part of their long-term memory. They build a basis for planning actions that lead to a specific outcome and influence attitudes toward certain actions. Knowing the structure of anglers' mental models about stream and river ecosystems is a key factor of understanding their beliefs about managing a natural resource.

Specifically, our research questions were as follows:

1. What are the mental model(s) of stream and river ecosystems and trout population dynamics of Swiss anglers? Which relations in the mental models indicate whether stocking is seen as the most preferred management tool?

2. Do anglers possess various mental models with regard to stocking?

3. Do different types of mental models have consequences for anglers' attitudes toward stocking, preferences for management tools and pro-ecological orientation?

By pursuing these questions, we seek a better understanding of anglers' beliefs about managing a natural resource and why they suppose certain actions lead to certain outcomes. In addition, we will draw conclusions and make suggestions about to promote more ecologically orientated management behaviour among anglers. Furthermore, we aim to contribute to finding methods suitable for eliciting mental models in general.

To assess these questions, we designed a preliminary qualitative study with the goal of learning what anglers find most relevant for stream ecosystems and the size of trout populations (chapter V.2). A second study was designed as a nationwide survey among Swiss anglers with the goal of validating the results of the preliminary study and analysing the consequences of attitude toward stocking, preferences for management tools and pro-ecological orientation (chapter V.3).

V.2 Qualitative Study

The preliminary study targeted our first research question, concerning the constitution of anglers' mental models of stream and river ecosystems and trout population dynamics.

V.2.1 Methods

We designed an interview study and used annual general meetings of fishing clubs to recruit fishermen of different ages and with different levels of fishing experience. We informed them of our research project, and 12 anglers were willing to participate. In the next few days, we telephoned the participants and informed them again of the project background, the approximate duration of the interviews, and then made an appointment to meet at a time and place of their choice. The only requirement was that the interviews should be conducted in a quiet, calm and undisturbed environment. After the telephone conversation, all 12 anglers agreed again to participate.

To collect the anglers' mental models, we used two methods: (a) open-ended theme-focussed interviews (Witzel, 1985, 2000), followed by (b) a modified version of the Heidelberger

Struktur-Lege-Technik [structure-laying technique, SLT] (Scheele and Groeben, 1988), which are addressed below.

(a) Open-ended theme-focussed interviews

In accordance with Witzel (1985, 2000), we had developed a short pre-interview questionnaire containing socio-demographic questions and items to provide us with information about the anglers' experience and background. While the participant filled out the questionnaire (which took approximately 5 minutes), the interviewer prepared the interview material and set up the voice recorder. Each interview took between one and two hours in total.

The recorded interviews were partially transcribed, though no content analysis in the sense of Mayring (1983) was needed. For our goal of collecting the anglers' mental models, it was sufficient to record the key concepts regarding topics and processes in stream and river ecosystems and their interdependencies mentioned by the interviewees.

(b) Modified version of the structure-laying technique (SLT)

Immediately after the interview, a modified version of the SLT was introduced: The interviewee was asked to recapitulate the main topics of the interview and to list these one by one on red cue cards (so one cue card for each topic resulted). As soon as one cue card was completed, the interviewer asked which mentioned (or still unmentioned) topics were related and how these relationships could be described. If the interviewee did not produce a topic, the interviewer chose a topic from the interview and asked for other related topics or processes affected by this topic. The mentioned relationships were then drawn on green cue cards by the interviewer and placed between the red cards according to the interviewees' assignment. The interviewee was asked at regular intervals if the laid-out structure was complete or if there were any missing relevant concepts or relationships. Once the interviewee had completed the structure, the interviewer started to summarize it and made sure he understood it correctly. If there was disagreement between the interviewer and the interviewee, the interviewer asked what was meant by the part of the structure in question, and the structure was revised, if required. All conversation during the development of the structure was voice-recorded and the resulting structure was photographed. This application of the modified version of the SLT took between 30 minutes and 1.5 hours. All photographed structures were later transferred into formalized diagrams. The results derived from both methods were merged and analysed as a single-structure diagram, which represents the mental model of a single participant.

V.2.2 Results

All participants were German-speaking male anglers. Their ages ranged from 24 years to 80 years (mean 52, SD 16.44). The interviewees can be considered experienced anglers, as they had started fishing between 11 years and 74 years ago (mean 38.5 years, SD 17.96). All 12 participants stated that they were members of recreational fishing clubs and that the rivers and streams they fished regularly were managed by stocking. The attitude toward stocking was measured on a four-point scale ranging from 'very good' to 'very bad'. Most of the interviewees rated stocking as rather good (72.7%) or very good (9.1%). Only 18.2% considered it rather bad.

One interview contained SLT data from two persons: a father and son who were interviewed separately, but constructed the mental model structure together. Another interview was excluded because the interviewee often drifted afar from the interview topic. Thus, a total of 10 mental models were constructed. When analysing the interview transcripts and SLT data, we found that the interviewees had detailed and complex mental models about stream and river ecosystems and about trout population dynamics. Figure 7 in chapter III.2.2 shows an example of such a mental model. All of the other nine mental models were of a comparable complexity.

We analysed all results individually and identified 13 key concepts that had a major impact on stream and river ecosystem processes from the anglers' point of view. These highly interconnected key-concepts were habitat, water quality, 'degree of naturalness' (In German: *Naturnähe*; a high degree of naturalness means a pristine river, in an almost undisturbed, natural state), river morphology, food availability, (chemical) impairments, trout population size, natural reproduction, fish health, stocking, conservation of local populations, predators and river management in general (Figure 1).

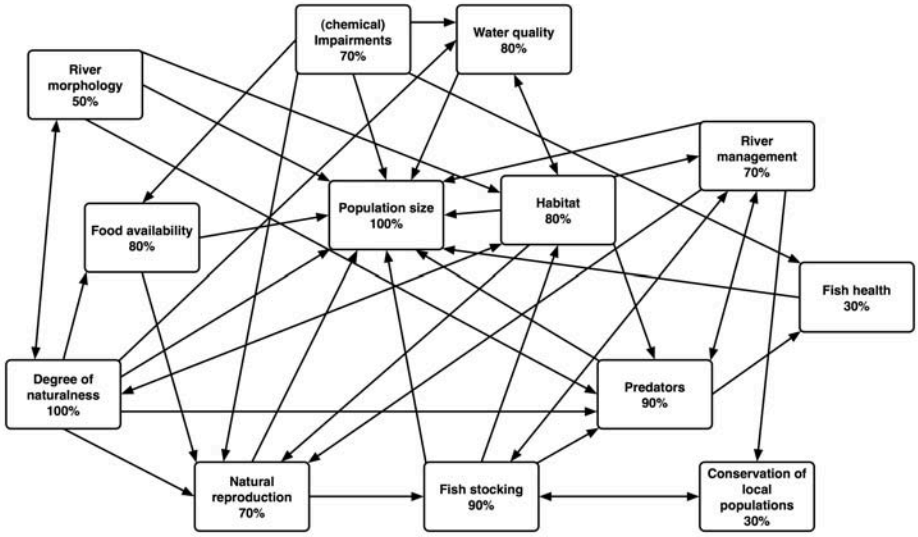

Figure 16 [Figure 1 of chapter V]. Key-concepts derived from interviews and SLT (n = 10). Percentages below concept names indicate how many anglers mentioned the concept. The arrows indicate which concepts affect which other concepts over all participants.

Even though conservation of local populations and fish health were only mentioned by 30% of the participants, these concepts were integrated for theoretical reasons. Conservation of local populations is essential for sustainable and pro-environmental fisheries management. As a result of selection, driven by local conditions, local populations are optimally genetically adapted to their respective environment (Hallermann, 2003). Stocking can potentially disrupt local adaptation and inter-population differentiation through admixture with conspecifics from other, not locally adapted, populations and/or from descendents of hatchery strains or inadequately managed (local) breeding programs.

Fish health was included in the key concepts because impaired health has been identified as a key factor responsible for the decline of trout catches in Switzerland (Burkhardt-Holm et al., 2005).

Besides reconstructing the anglers' mental models about stream and river ecosystems and trout population dynamics, we analysed the results on an individual level (all 12 interviews were included) and found two different recurring structures regarding trout population size, fish stocking and natural reproduction (Figures 2a and 2b).

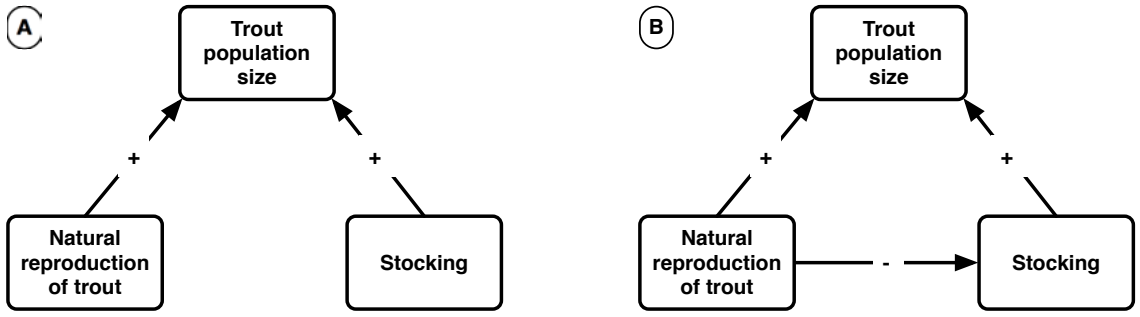

Figure 17 [Figure 2a and 2b of chapter V]. **Figure 2a.** Additive model derived from the interviews. Stocking and natural reproduction affect the trout population in an independent and additive way (N = 8). **Figure 2b.** Compensatory model derived from the interviews. Stocking and natural reproduction affect the trout population interdependently. Stocking is only needed if natural reproduction is insufficient. The better the reproduction the less stocking is needed (N = 4).

Eight out of the 12 participants stated that stocking and natural reproduction affect the trout population size in an independent and additive way (Figure 2a). The remaining four anglers linked the need for stocking to the degree of natural reproduction (Figure 2b). They saw stocking as compensation for insufficient levels of natural reproduction. Therefore, we labelled the anglers with the first model as additive-thinking anglers (or 'additives') and the anglers with the second model as compensatory-thinking anglers ('compensatories').
With these results, our first two research questions can be answered. We identified (a) that Swiss anglers' mental models contain 13 key concepts regarding stream and river ecosystems and trout population dynamics and (b) that there are two different types of mental models (additive and compensatory) with respect to stocking, natural reproduction and the size of trout populations.

V.2.3 Conclusions from the preliminary study

The high degree of interrelatedness between the 13 key concepts leads to the assumption that Swiss anglers have complex mental models about stream and river ecosystems. The finding of an additive and a compensatory type of mental model regarding stocking, natural reproduction and trout population size indicates that the compensatory thinking anglers might process information more adequately when thinking about fisheries management than the additive thinking ones. We pursued this hypothesis in our quantitative follow-up study.

V.3 Quantitative Study

Our main goal for this study was to collect anglers' mental models about stream and river ecosystems on a broader scale. Additionally, we wanted to examine (a) whether the additive or compensatory model led to any differences in the interrelationships between the 13 key concepts derived from the interviews, in attitudes toward stocking, in preferences for fisheries management tools and in pro-ecological orientation issues, and (b) whether these two types of mental model could be reproduced in a larger sample.

V.3.1 Methods

A paper-and-pencil questionnaire was mailed to 2,773 German-speaking and 542 French-speaking Swiss anglers. We also constructed an online version, whose layout and wording were made equivalent to the print version to ensure comparability (Batinic and Bosnjak, 2000; von Lindern, 2006). We added this questionnaire to our project homepage and e-mailed the link to fishing-related Internet discussion groups in Switzerland.

The questionnaire consisted of four parts. The first part contained demographics and basic questions about fishing behaviour (e.g., 'How many streams and rivers do you fish regularly?'). The second part dealt with experience with and perception of fishing, streams and rivers and fisheries management, and was used to collect the mental models. We included an open-ended question for every aspect that was mentioned as relevant by the interviewed anglers and asked how these concepts were interconnected. We employed open-ended questions because we wanted to determine if the open answers could be categorised into the 13 key concepts derived from the interviews, or if other/additional concepts would result. These questions were ordered directly after the first section of questions because we wanted to minimise a learning bias that might result from thinking about answers to other questions related to fisheries. Figure 8 in chapter III.3.1 (version 'D') shows the final version of the open-ended questions after pre-testing different designs. We additionally included an item that was designed to discriminate between compensatory- and additive-thinking anglers (for the exact wording see chapter V.3.2.2). Further, we asked for experiences with, attitude toward and motives for stocking, as well as which management tools the participant preferred. The third part of the questionnaire contained questions regarding pro-ecological orientation. The last part included questions about the understandability of the questionnaire and provided an opportunity for feedback and criticism.

In total, the questionnaire consisted of 200 closed and 37 open-ended items on 23 pages. Completion required approximately one to two hours.

V.3.2 Measurements

This section details the items we used to assess our research questions.

V.3.2.1 Reconstruction of mental models

To collect the mental models, we formulated the following item: 'From your point of view, what has the strongest impact on the following? Please write down the three factors that have the most positive/beneficial (negative/hindering) impact on each topic.' (Chapter III.2.2, Fig. 7, version 'D'). We asked for positive and negative impacts on the 13 key concepts derived from the interviews and provided extra space for topics added by the respondent. We used an open answer format because we wanted to collect the impact factors in the participant's own words to prevent suggestions. Thus, we included a total of 26 open questions devoted to eliciting interrelations between the 13 concepts derived from the interviews and two open questions that allowed new topics to be introduced.

Regarding stocking, we asked directly for the relationship between natural reproduction and the need for stocking: 'How would you describe the influence of the following changes on stocking? If there is more natural reproduction…' with the possible answers: 'Stocking is needed more', 'This does not impact the need for stocking', 'Stocking is needed less' and 'I do not know'. We combined this item with the open item mentioned above because we thought that the answers collected for the open question might cover too broad a range and the answers from the closed item might be too suggestive for collecting the mental models. These possible effects will be considered when analysing the results.

V.3.2.2 Allocation of anglers to the additive or the compensatory mental model type

We implemented the question, 'Fish stocking should be done independently from natural reproduction', with the five-point answer scale ('totally agree', 'mostly agree', 'partly agree, partly disagree', 'mostly disagree', 'totally disagree') to gather information about the distribution of additive and compensatory thinking in our sample. The choices of 'mostly disagree' and 'totally disagree' reflected the compensatory model, or in other words: a high degree of compensatory thinking. Anglers who answered 'partly agree, partly disagree' were not taken into account because they could not be clearly allocated to either of the two groups. The item was formulated to give the best representation of the differences between the additive and compensatory model so it could be used as a grouping variable.

V.3.2.3 Attitude toward stocking

Attitude toward stocking was measured with three items: The first item was formulated 'I think stocking as a management tool in rivers with a high degree of naturalness is…' with the five-point answer scale ('very good', 'rather good', 'neither good nor bad', 'rather bad', 'very bad'), followed by the next attitude statement, 'I think stocking as a management tool used in rivers with a low degree of naturalness is…' with the same answer scale. The third attitude item was worded 'Generally, stocking is, in my opinion…' with the 10-cm visual-analogue answer scale (Reips and Funke, 2008) ranging from 'very good' to 'very bad'.

We differentiated between (near-) natural (high degree of naturalness) and degraded (low degree of naturalness) rivers and streams because, from a biological point of view, this is decisive whether stocking might be useful to maintain trout population sizes; fish need a natural or near-natural habitat to maintain self-sustaining populations. This is particularly true for trout (Burkhardt-Holm et al., 2005). Salmonid (salmon and trout) habitat is a complex and interactive mixture of water quality, quantity and physical structure. If any one component is inadequate or degraded by human activities or construction, salmonid productivity will decline (Hendry et al., 2003). In such cases, stocking has the potential to mitigate insufficient natural reproduction if the survival and growth of the stocked fish is supported by the habitat. However, in (near-natural) rivers and streams, conditions for natural reproduction are favourable, and the number of recruits might correspond to the carrying capacity of the habitat. Stocking is in that case unnecessary and, if conducted anyway, likely to be either unsuccessful or harmful.

If compensatory-thinking anglers take into account aspects of the ecosystem in a biologically more adequate way and have a higher degree of pro-environmental orientation than additive anglers, we expect them to discriminate between environments with high and low degrees of naturalness when rating stocking.

V.3.2.4 Preference for management tools

To assess management preferences, we asked for a ranking of different management tools: 'Which of the following management tools is best suited for increasing the size of trout populations?' We listed the following alternatives (in order of appearance): stocking, size limits, closed seasons, closed areas, bag limits (restriction of fish harvested per day and/or fishing season), limiting effort (by restricting access to fishing sites by, e.g., limiting the number of anglers admitted or of days open to fishing) and fishing bans. The participants

were to allocate numbers in ascending order to the tools, beginning with '1' for the most powerful and ending with '7' for the least powerful.

V.3.2.5 Pro-ecological orientation of anglers

As a measurement of pro-ecological orientation, we implemented the new ecological paradigm scale (Dunlap et al., 2000), adapted to the fisheries context by Arlinghaus (2004) and Arlinghaus and Mehner (2005). The modified scale consists of 13 items and should measure the pro-ecological orientation of anglers in general. For the exact wording see Table 1 (chapter V.3.3.2.3). All items could be answered on a five-point scale ('totally agree', 'mostly agree', 'partly agree, partly disagree', 'mostly disagree', 'totally disagree'). Agreement on items 1, 2, 4, 6, 9, 12 and 13 and disagreement on items 3, 5, 7, 8, 10 and 11 reflect a high pro-ecological orientation. The statements were originally formulated in German by Arlinghaus (2004).

V.3.3 Results

Response rates varied between 12.3% (German-speaking sample) and 14.0% (French-speaking sample), and we received a total of 418 questionnaires. The respondents were between 16 years and 86 years in age (mean: 53.31, SD 14.38). Of all of the respondents, 96.4% were male and 1.4% female, and 2.2% of the answers were missing. As far as residence, 57.4% of the participants lived in the countryside, 33.5% in suburbs or small towns and 8.6% in cities (no data: 0.5%).

Mean angling experience was 38.1 years (min: 2, max: 80, SD 15.8), and 83.5% of the participants were members of a fishing organisation. Of the surveyed anglers, 91.9% fished in streams or small rivers (exclusively, often, sometimes or seldom), and 87.7% fished in large rivers and therefore had direct experience with water bodies inhabited by trout.

V.3.3.1 Reconstruction of mental models

By grouping the participants into either the additive or compensatory mental model, we referred to our second research question and wanted to analyse differences regarding stocking, as was found in the interview study. To assess the mental models, we categorised 7,843 answers given to the open-ended questions. A total of 34 categories resulted and defined the anglers' mental models. To reduce complexity, we only assessed categories with answers given by at least 5% of the respondents for further analysis. To measure the reliability of the categorisation, we calculated Cohens κ. The recategorisation was performed

by an environmental engineer and a psychology student. Due to the huge number of answers collected, a random sample of 15 answers per open question was assessed. Nevertheless, the recategorised 390 answers resulted in a Cohens κ of 0.75. According to Greve and Wentura (1997), this can be interpreted as 'good' to 'excellent'.

The concepts identified were highly interconnected, and the 13 key concepts derived from the interviews acted as main nodes for the relationships. These main nodes were directly or indirectly linked to each other through new influence nodes. For example, the size of trout populations was linked directly to predators and vice versa, while food availability and natural reproduction were connected indirectly to each other through riverbed structure. Even though we expected the compensatory-thinking anglers to identify sufficient natural reproduction as the most important factor, less then 5% of them did so. Otherwise, when we used the dichotomised grouping statement (agreement or disagreement on 'Stocking should be done independently of the sufficiency of natural reproduction') to allocate the anglers to one model or the other, we found that 64.5% (207) of the total sample totally or partly agreed with the statement, while 35.5% (114) totally or partly disagreed. A total of 17.7% answered partly agreed/partly disagreed and could therefore not be allocated to either group. Finally, 5.5% preferred to give no answer. The ratio of 1.9:1 for additive- to compensatory-thinking anglers represented the ratio of 2:1 found in the preliminary study very well. Then, taking this grouping as a basis for finding differences in the mentioned frequencies of relationships between the 13 interview-derived key concepts, we constructed a mental model for each group.

As a first descriptive result, obtained by applying the at-least-5%-answer-frequency criterion, additive and compensatory anglers seem to use different concepts to build their mental models. For example, we found that less than 5% of the additives considered 'regulations for conservation of local populations' and 'catch records and population monitoring' as relevant influencing concepts. On the other hand, the anglers allocated to the compensatory model were not likely to attribute much influential power to concepts like the 'use of water energy (hydropower)' and 'oxygen concentrations'.

When the relationships between all used concepts were examined, we found that the main results from the qualitative preliminary study, namely, that anglers with the additive type of mental model think stocking should be done independently of the efficiency of natural reproduction, were represented in the data from the nationwide Swiss sample (Figures 3a and 3b).

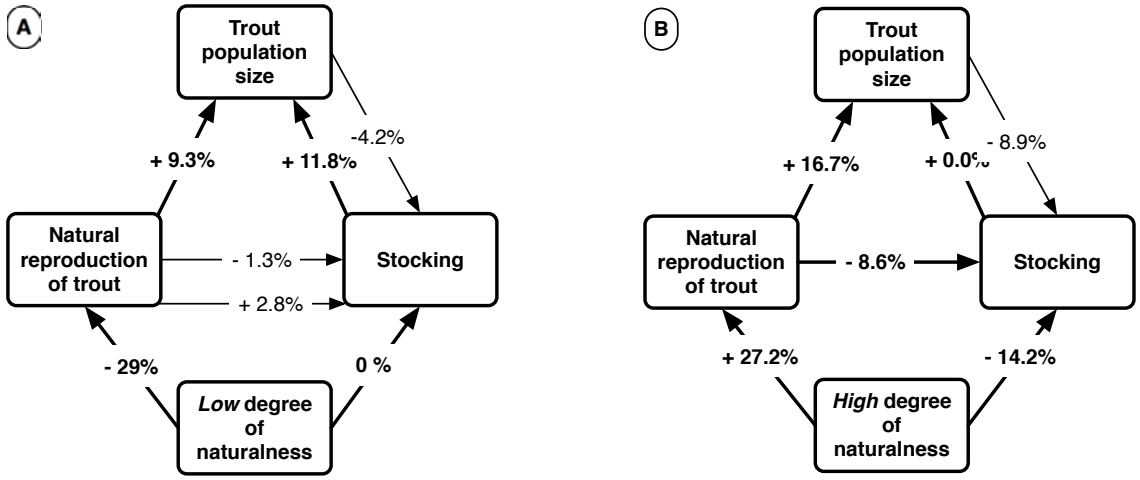

Figure 18 [Figure 3a and 3b of chapter V]. **Figure 3a.** Replication of the additive mental model for the Swiss-wide sample. Percentages represent how many anglers mentioned this relation as most influencing for each concept (n = 207). **Figure 3b.** Replication of the compensatory mental model for the Swiss-wide sample. Percentages represent how many anglers mentioned this relation as most influencing for each concept (n = 114).

Natural reproduction was seen by 9.3% of the additives as the most powerful influence on the size of trout populations, while 11.8% thought stocking had the strongest impact. By contrast, 16.7% of the compensatory-thinking anglers claimed natural reproduction was most influential on trout population size. None of the anglers attributed stocking in the first order to having an influence on the size of trout populations. Of the compensatories, 8.6% mentioned a negative influence of sufficient natural reproduction on stocking. Stocking was seen as a compensation for a lack of natural reproduction. An even larger number, 8.9%, of the compensatories thought that good sized trout populations had the most negative impact on the necessity for stocking, while only 4.2% of the additives claimed to take the actual size of the population into account (Figures 3a and 3b). Interestingly, 1.3% of the additives showed the 'typical' compensatory belief that, 'the more natural reproduction, the less stocking is needed', and 2.8% of the additives said that more natural reproduction should lead to more stocking (Figure 3a). At first glance, these percentages do not seem very high, especially if a major difference between both mental models should be the negative link from an efficient natural reproduction to the need for stocking. However, this percentage has to be seen in the context of the open question, 'From your point of view, what has the most negative impact on stocking?' where respondents could write whatever answer came to mind. With a frequency of 8.6%, 'natural reproduction' was among the most frequent answers given, after 'lack of

expert knowledge regarding stocking' (17.6%), 'high degree of naturalness' (14.2%), 'origin of fish: foreign' (13.8%), 'no catch records and no population monitoring' (12.0%) and 'good size of trout populations' (8.9%). The missing 24.9% to 100% were distributed among 37 other categories.

Of the compensatories, 27.2% stated that 'degree of naturalness' had a positive effect on 'natural reproduction'. When this positive relationship and the negative relationship between 'degree of naturalness' and 'stocking' were taken into account, it became obvious that the concepts of 'natural reproduction' and 'degree of naturalness' were not independent from each other. Therefore, some part of the frequencies found for the relationship between 'degree of naturalness' and 'stocking' might result from the dependency between 'natural reproduction' and 'degree of naturalness'. For the additives, we found no relationship between the concepts 'degree of naturalness' and 'stocking', even though 29% of additives mentioned the negative impact of a low degree of naturalness on natural reproduction. However, they did not link this impact to 'stocking'.

Therefore, we concluded that the compensatory-thinking anglers were more likely to think of stocking if natural reproduction was insufficient, if the river or stream was degraded (low degree of naturalness) and if the trout population size was low. On the contrary, the additive-thinking anglers were less likely to take these concepts into account when thinking about stocking. This result is in line with the prior-mentioned finding that only less than 5% of the additive-thinking anglers attributed a high influential potential to the monitoring of populations and used it as a concept in their mental model. On the other hand, 12.0% of the compensatory-thinking ones did use the concept. In terms of the relationships between 'conservation of local trout populations', 'natural reproduction' and 'stocking', we found a similar picture: 10.7% of the additive-thinking anglers thought that natural reproduction had the most beneficial effect on the conservation of local trout populations, compared to 9.0% who cited stocking instead. By contrast, 7.5% of the compensatory anglers saw stocking as the most negative influence on the conservation of local trout populations, compared to 21.2% of the additive-thinking anglers, who viewed natural reproduction as the most positive influence.

Further support for the conclusion that compensatory-thinking anglers were more likely to consider the degree of natural reproduction when thinking about stocking came from the answers to the question, 'How would you describe the influence of the following changes on stocking? Through more natural reproduction…'. Of the additives, 11.7% (n = 197) claimed that more natural reproduction increases the need for stocking, compared to none of the

compensatories (n = 109). Another 11.2% of the additives, in contrast to 2.8% of the compensatories, said that more natural reproduction does not affect the need for stocking. Finally, 77.2% of the additives and 97.2% of the compensatories indicated a decreasing need for stocking due to increased natural reproduction. These differences were highly significant (U-test, z = –4.677, $p < 0.0001$).

In summary, the two mental models (additive and compensatory) of stocking identified in our study differed significantly: The additive-thinking anglers mentioned positive effects of stocking on population size significantly more often than did the compensatory-thinking ones. Additionally, the analysis of the open questions showed that compensatory-thinking anglers viewed stocking as more negative for the conservation of local populations.

V.3.3.2 Implications of different mental models

With our third research question, we wanted to analyse the consequences of these two types of mental models for the attitude toward stocking, the preference for management tools, and the pro-ecological orientation of anglers.

V.3.3.2.1 Attitude toward stocking

The Kolmogorov-Smirnov Test for normal distribution showed that answer frequencies of all three attitude items differed significantly from following a normal distribution (attitude toward stocking in rivers with high degree of naturalness z: 4.246, $p < 0.0001$; attitude toward stocking in rivers with low degree of naturalness z: 5.126, $p < 0.0001$; attitude toward stocking in general z: 1.828, $p = 0.002$). Therefore, we used non-parametric statistics for further analysis.

Next, we calculated Spearman's rank correlation for the type of mental model (depending on the degree of compensatory thinking, whereas a high degree of compensatory thinking meant the allocation to the compensatory group and a low degree of compensatory thinking the allocation to the additive group) and the three attitude items. We found a significant correlation of 0.549 ($p < 0.001$) for degree of compensatory thinking and the attitude toward stocking in rivers with a high degree of naturalness and a significant correlation of 0.527 ($p < 0.001$) for the degree of compensatory thinking and the attitude toward stocking in general. Both correlations can be classified as medium strength correlations (Bühl and Zöfel, 2002). The correlation for the degree of compensatory thinking and the attitude toward stocking in rivers with a low degree of naturalness was insignificant (r = –0.050, $p = 0.380$).

In general, additive-thinking anglers in our sample had a significantly higher attitude toward stocking than compensatory-thinking ones: For the scale, "Attitude toward stocking in general", the additives received a mean of 75.36 (SD 20.05) while the compensatories reached 44.21 (SD 27.43) on an answer scale ranging from 100 = very good to 0 = very bad (U-test: $z = –9.079$, $p < 0.001$). We found a comparable result for the attitude toward stocking in rivers with a high degree of naturalness: On a scale from 1 (very good) to 5 (very bad), additives stated 'rather good' (mean 2.24, SD 1.01) on average, while the compensatory-thinking anglers rated it as 'rather bad' (mean 3.73, SD 1.12; U-test: $z = –9.738$, $p < 0.001$). For the attitude toward stocking in rivers with a low degree of naturalness, the difference was insignificant (U-test: $z = –0.880$, $p = 0.379$).

We concluded that anglers allocated to the additive mental model had a high attitude toward stocking in general and did not discriminate between rivers with a high or low degree of naturalness. By contrast, the compensatory-thinking anglers' attitude depended on the degree of naturalness: If a river had a high degree of naturalness, the compensatory-thinking anglers were likely to reject stocking. Moreover, their general attitude toward stocking was rather low.

V.3.3.2.2 Preference for management tools

A second aspect of our third research question was whether there is a relationship between the type of mental model and preferences for fishery management tools. We analysed whether the additive and compensatory models would lead to any differences in terms of preference for common fishery management tools. We calculated a power index for every management tool by summing the product of the answer frequencies multiplied by the rank (1 to 7). The result was normalised for both groups to create comparability. Figure 4 shows this normalised power index for additive and compensatory thinking anglers.

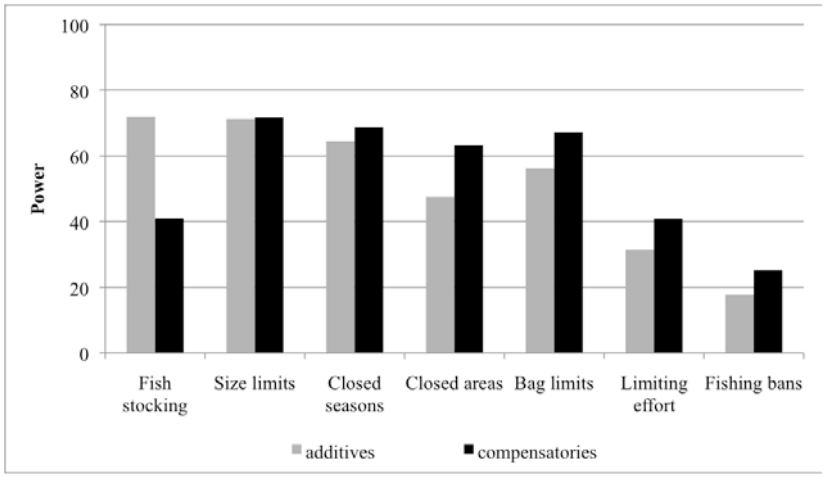

Figure 19 [Figure 4 of chapter V]. Power index regarding different fisheries management tools for additive and compensatory anglers. The higher the index the more power is attributed to the tool.

The strongest differences between additives and compensatories were found for the power attributed to stocking and closed areas. Additives stated that stocking was approximately twice as powerful (71.9, rank: 1st) as did compensatories (41.0, rank: 5th; χ^2: 8.504, $p = 0.004$). All other differences were not statistically significant. Interestingly, the calculated power index revealed that stocking and size limits, followed by closed seasons, were perceived as almost equally as powerful for the additives. For the compensatories, size limits and closed seasons were also ranked as the two most powerful tools. The differences to the first rank were insignificant. Within each group, the differences in the power index between the management tool ranked most powerful and that ranked least powerful were highly significant (additives: stocking vs. fishing bans, χ^2: 32.400, $p < 0.0001$; compensatories: size limits vs. fishing bans, χ^2: 22.773, $p < 0.0001$).

Overall, we found significant differences between additive- and compensatory-thinking anglers with regard to their preferences for fish stocking as a fishery management tool.

V.3.3.2.3 Pro-ecological orientation

The last aspect of our third research question referred to differences between additive- and compensatory-thinking anglers in their pro-ecological orientation.

A first analysis showed that the answer frequencies for all items of the pro-ecological orientation scale (Arlinghaus 2004) differed significantly from the normal distribution (Kolmorgorov-Smirnov-Test, with z ranging from 3.333 to 6.535, $p < 0.0001$). Therefore, we used the non-parametric Mann-Whitney U-Test to test for differences. The results are displayed in Table 1.

Table 8 [Table 1 of chapter V].
U-Test for differences in items measuring pro-ecological orientation between anglers who have been allocated to either the additive or the compensatory type of mental model.

Item Nr.	Item/Statement	Means* Add	SD	Comp	SD	z	p
1	Fish and other animals have the same rights as we humans	2.45	1.25	2.49	1.48	-0.177	0.860
2	Rivers are like isolated spaces with limited amount of fish[a]	2.72	1.14	2.62	1.39	-1.095	0.274
3	To satisfy our own needs we fishermen have the right to change the natural running waters	4.25	0.9	4.58	0.84	-4.177	0.000
4	When we anglers interfere with an aquatic ecosystem, it often produces disastrous consequences	3.06	1.3	3.15	1.36	-0.651	0.515
5	The balance of the aquatic ecosystem is strong enough to cope with the impacts of us anglers	3.10	1.13	3.30	1.18	-1.416	0.157
6	We are approaching the limit of the number of anglers that the aquatic ecosystem can support	3.27	1.11	3.35	1.15	-0.575	0.565
7	We anglers impact on the aquatic ecosystem less than other stakeholders	1.92	0.93	2.38	1.05	-3.894	0.000
8	The discussion about the decline of trout populations in Switzerland is strongly exaggerated[a]	3.92	1.08	4.16	1.02	-2.045	0.041
9	If we anglers continue in the present course, we will soon experience an ecological catastrophe in the aquatic ecosystem	3.89	1.09	3.61	1.14	-2.346	0.019
10	We anglers are well qualified to manage and protect the aquatic ecosystem	1.80	0.89	1.91	1.04	-0.561	0.575
11	As anglers our ability to learn and our power of observation will insure that we do not overfish the aquatic ecosystem	2.08	0.98	2.35	1.15	-1.855	0.064
12	It is still a fact that we anglers do not enough to protect the aquatic ecosystem	2.85	1.24	2.23	1.09	-4.361	0.000
13	We anglers should be ready to change our behaviour in favour for the protection of running waters	3.02	1.24	2.31	1.17	-4.902	0.000

** Note: We inserted the means and standard deviations for the items instead of the mean ranks used by the U-test for a better visualisation of the differences between additive and compensatory thinking anglers.*

[a]: These items have been modified from the original wording to better fit the Swiss context.

Additive- and compensatory-thinking anglers differed significantly in six of 13 statements on pro-ecological orientation. When looking at the means for both groups, it becomes obvious that the compensatory anglers have a higher pro-ecological orientation than additive-thinking anglers. On the one hand, all six significant differences went in the 'pro-ecological direction', in favour of the compensatories. On the other hand, we only found six out of 13 differences being significant between these groups. Apart from statements 3, 12 and 13, it is not clear if the differences are also empirically significant.

In a second step, we analysed the entire pro-ecological orientation scale for internal consistency, which resulted in a Cronbach's alpha of 0.66. Even though this is not very high, it is still acceptable. Ahrlinghaus and Mehner (2005) found comparable values for Cronbach's alpha ranging from 0.54 to 0.66, regarding the modified NEP scale. After conducting the Kolmogorov-Smirnov test on normal distribution (z: 0.975, $p = 0.297$), we compared the means of the summed score between compensatory- (mean 40.71, SD 6.91) and additive-

thinking (mean 37.8, SD 6.23) anglers with a t-test and found that they differed significantly (t: –3.722, $p = 0.000$).

We concluded that, in general, anglers with a compensatory mental model have a significantly higher pro-ecological orientation than anglers with an additive mental model.

V.3.4 Discussion

In their mental models, compensatory-thinking anglers mentioned more frequently biologically adequate interrelationships between stocking, natural reproduction and the degree of naturalness than the additive-thinking ones, even though these frequencies were not as high as we had expected. For the additives, we found no such patterns of connectedness. Furthermore, while a frequent statement by the additives was that stocking had the most positive effect on the size of trout populations, none of the compensatories mentioned this impact as being the most influential. Instead, compensatories tended to mention the opposite, namely, that stocking was more threatening to the conservation of local trout populations than any other item. By contrast, the additives were likely to attribute the most positive power to stocking for the conservation of local trout populations. This consistent rating of stocking was identified again when we asked directly for their attitude toward stocking in general and in rivers with a high/low degree of naturalness. Thus, the overall picture for both groups was consistent.

Another aspect of our results is that the anglers in our sample possessed complex expert knowledge about processes in stream ecosystems regarding trout population dynamics. Almost every single participant gave us a vast set of answers and explanations of their view of how stream ecosystems work. Given this finding, we think that stakeholder involvement in environmental management does more than merely increase acceptance and compliance of promoting management methods based on scientific knowledge (Beierle, 2002; Morrison, 2002). Furthermore, mental models of stakeholders have the potential to enhance and increase scientific knowledge because stakeholders have a large amount of on-site experience with their primary target system (in our case, stream and river ecosystems). Additionally, the information gap between scientist and stakeholders described by Kolkman et al. (2005) can be reduced by first analysing mental models, then learning how a system works from the stakeholder's point of view and finally adjusting communications to fit into both the stakeholders' and scientists' mental models.

Besides the complexity and constitution, the content of the additive and compensatory mental models is essential to understand stakeholders in environmental management. According to research in the domain of mental models (e.g., Johnson-Laird, 2006; Kaplan and Kaplan,

2009; Kolkman et al., 2005; Markman and Gentner, 2001; Morgan et al., 2002; Norman, 1983), it is necessary to know people's mental models to understand their reasoning and action planning in specific situations and environments. For example, by analysing and comparing both types of mental models identified in this study, we were able to understand the different preferences for management tools. Specifically, the anglers allocated to the additive type of model thought of stocking as a positive influences for trout population size and for conservation of local trout populations in their mental models, while the anglers who belonged to the compensatory-thinking group did not mention stocking among the impact factors for the trout population size and saw it as a potential threat to fish conservation. Additionally, the additive-thinking anglers mentioned fewer possible risks associated to stocking than the compensatory thinking anglers did. In consequence, they ranked stocking as the most powerful management tool among seven other tools. Similarly, for compensatories, the relationships in the mental model regarding stocking, population size and conservation of local trout populations corresponded to their ranking of management tools; stocking was ranked fifth.

Thus, it can be concluded that both compensatory- and additive-thinking anglers reason rationally according to their beliefs. In general, both of these mental models could coexist. However, if one considers the decline in trout catches reported by Burkhardt-Holm et al. (2005), the role of traditional stocking practices and potential associated risks (Cooke and Cowx, 2006), the compensatory model becomes the more adequate mental model because more commensurate aspects are considered when thinking about fishery management tools. The achieved scores on the pro-ecological orientation scale support this finding, as they were significantly higher for compensatory anglers than for additives.

Overall, these results implicate promoting compensatory thinking as a possible way of establishing more adequate and pro-environmental fisheries management among anglers. This could be achieved by e.g. showing the additive-thinking anglers a lack of functionality of their mental model for achieving their specific goals or by proving that the compensatory model has a superior functionality for reaching their management goals (for intervention planning based on mental models see e.g. Breakwell, 2001; for the role of functionality of mental models e.g. Norman, 1983). In our case, this would mean creating a training program or information material that concentrates on the relationships between the need for stocking, the degree of naturalness and the efficiency of natural reproduction. The potential negative impact of stocking on local populations and on the ecosystem as well as alternatives to stocking (or stocking practice) should also be implemented.

V.4 Limitations of the Studies

Even though we found reasonable and consistent results, there are limitations to this study. First, response rates between 12.3% and 14.0% are remarkably low. It is reasonable to assume that a 23-page questionnaire that required one to two hours to complete is much too long and demanding. However, in the pre-tests, response rates varied between 60% and 100%. A possible explanation for this difference might be that we contacted the pre-test persons directly by telephone and actively asked them to participate, whereas the actual questionnaire was mailed to the rest of our sample without any personal contact. Overall, a sample size of 418 is reasonable, even if we cannot generalize the results to the entire Swiss angler population. Further, it is possible that only very motivated and fishery-centred anglers completed the survey, which could have biased the results. But nevertheless, the understanding of their motives and beliefs about river and stream ecosystems is very valuable for future research and fisheries management.

Another limitation concerns the methodology of collecting mental models: Norman (1983) pointed out that a question about direct relationships between concepts might produce a spontaneous mental model about a potentially good answer to the specific question. We approached this general limitation to mental model research by choosing non-directive methods such as the open-ended theme-focussed interview and the structure-laying technique to elicit whatever came to mind during the interviews. Still, we cannot disregard that the interview situation did create an *ad hoc* mental model for that specific situation. In addition, in the quantitative follow-up study, we were forced to provide topics due to the nature of the mailed surveys. To impart as little influence as possible, we formulated open questions, positioned them in the first half of the questionnaire and allowed for other topics to be added. After conducting several pre-tests, this was identified as the most reasonable approach.

A further limitation is related to the pro-ecological orientation scale (Arlinghaus 2004): We found no validation in literature, and as Arlinghaus stated in his study, further research is needed to develop a reliable and valid scale for assessing the pro-ecological orientation of anglers (Arlinghaus, 2004, p. 94). However, we found no evidence that the surveyed anglers did incorrectly understood the items, nor can we conclude that the scale is suited to measure pro-ecological orientation in the sense of the new ecological paradigm. Therefore, we support Arlinghaus' statement that a validation of this scale is needed.

V.5 Overall Conclusions

We determined that our methods of collecting mental models were very well suited for answering our three research questions. From the preliminary interview study, we learned that Swiss anglers' mental models of stocking and trout population dynamics were very elaborate and complex. The interviewed anglers included 13 relevant and important concepts in their mental models regarding the stream and river ecosystem and trout population dynamics. We identified an additive and a compensatory type of mental model based on different interrelationships between these 13 concepts.

By conducting our quantitative follow-up study, we could replicate the major findings from the preliminary interview study. Furthermore, we found that, compared with additive-thinking anglers, compensatory-thinking anglers have a biologically more adequate mental model of river and stream ecosystems and trout population dynamics, a more differentiated attitude toward stocking and a stronger pro-ecological orientation. From these findings, we can draw the following conclusions:

1. The analysis of mental models provides a deeper understanding of what anglers think about fisheries management. Differences in attitude and preference for management tools can be explained by differences in the mental model.
2. Different interrelationships within both types of mental models provide a good approach for intervention planning. Intervention must first question the unfavoured relationships mentioned by the additive-thinking anglers, and then provide information and experience that are likely to create the relationships identified for the compensatory anglers. Thus, a more adequate (in the sense of pro-ecologic) mental model of stocking can be promoted.

These results and conclusions demand that further research be performed to gain a better understanding of how mental models impact stakeholders' beliefs about managing a natural resource.

V.6 Future Research

We have shown that the analysis of mental models provides a consistent and comprehensive understanding of how anglers think about managing a stream and river ecosystems by stocking. Mental models provide information suitable for explaining the relationships between psychological constructs (like attitudes and preferences) and beliefs. In general, the identification of different mental models has practical implications for applied science in environmental management. For example, the tailoring of interventions (Mosler and Martens, 2008) could be optimised and the effectiveness of communication strategies (Tamas, Tobias, and Mosler, 2009) enhanced by first examining mental models. By eliciting mental models about relevant topics, intervention could be designed to fit prominent issues within a target group. This would raise attractiveness and personal involvement, which would likely increase the effectiveness of an intervention.

Thus, we are convinced that the analysis of mental models can contribute to future research issues in the field of environmental management, though it is not limited to this specific area, and with methods like the structure-laying technique (Scheele and Groeben, 1988) or the open-ended theme-focussed interview (Witzel, 1985, 2000), we have shown that applied science has developed reasonable tools to assess mental models.

VI. Do Mental Models Matter for Resource Management?[4]

Abstract

Resource management is plagued by the well-known problem of stakeholders using management tools that are considered threats to the natural environment. In this study, we give the example of Swiss recreational fishermen (hereafter called 'anglers') as stakeholders in fisheries management. Our goal was to understand why anglers want to continue or even increase fish stocking, the intentional release of large numbers of fish into natural water bodies. Stocking, a traditional fisheries management tool, is increasingly questioned by freshwater scientists. First, we elicited the anglers' mental models about fisheries management and processes in the stream and river ecosystem. In a second step, we constructed a structural equation model to better understand how mental models influence anglers' attitudes and intentions regarding fish stocking. As a main result, we found attitude and intention were highly dependent on the perceived functionality of fish stocking, the perceived state of the environment and the frequency with which an angler participated in fish stocking-related activities in the past. We conclude that analysing mental models contributes to the understanding of resource management and is a very promising approach to tailoring interventions.

Keywords: mental model, resource management, intervention planning, fish stocking

[4] This chapter was designed as a stand-alone manuscript for publication in Society & Natural Resources, where it is currently under review. Authors: Eike von Lindern, Hans-Joachim Mosler.

VI.1 Introduction

Human behaviour and management of natural resources are common and relevant topics to environmental psychology (Gifford, 2009; Jager and Mosler, 2007). Moreover, the importance of environmental management has gained entry into politics and society, and stakeholders have become increasingly involved in scientific environmental management research (Beierle, 2002).

Therefore, analysing human behaviour regarding the management of natural resources is an important research field, which should keep up with and benefit from future research directions in environmental psychology. In a recent issue of the Journal of Environmental Psychology, Gifford (2009) commented on these future research directions and referred to the role of mental models in human information processes. We are convinced that analysing mental models is not only an excellent approach to gaining a better understanding of stakeholders' management behaviour, but also a very promising research field for intervention planning.

In the following, we first describe mental models research and, second, build a framework in which we link mental models to management intentions and attitudes toward fish stocking.

VI.1.1 Mental models research

Analysing mental models has become a challenge in a wide research field. Bostrom, Atman, Fischhoff, and Morgan (1994); Atman, Bostrom, Fischhoff, and Morgan (1993); and Morgan, Fischhoff, Bostrom, and Atman (2002) presented an application of mental models research to applied risk communication. Johnson-Laird (2006) demonstrated how mental models contribute to reasoning and making inferences, and Kolkman, Kok, and van der Veen (2005) introduced mental model mapping as a tool to support and enhance decision making in integrated water management. Schöll and Binder (2009) used a structured mental model approach to compare experts and farmers' system perspectives regarding the role of livelihood assets in risk perception.

Recently, Kaplan and Kaplan (2009) pointed out the relevance of eliciting mental models to their reasonable person model (Kaplan and Kaplan, 2003, 2009) and to the whole area of environmental psychology. According to Kaplan and Kaplan (2009), mental models can be understood as simplified mental representations of real-world systems. Furthermore, Kaplan and Kaplan (2009) stated that mental model building has been a key factor in human survival because people depend and rely on these models in everything they do. Additionally, they

explained that building mental models is a necessity for people to act meaningfully in any environment. Mental models provide an individual with the capacity to anticipate possible outcomes, to mentally simulate possible actions and dependent system reactions. Thus, any possible behaviour can be evaluated before it is actually carried out, which makes real-world action more effective because potential failure can be minimised *a priori* (Kaplan and Kaplan, 2009). However, the value of mental models in action planning depends on the model's functionality, by which we mean the degree to which a mental model represents the actual target system (e.g., the stream and river ecosystem) with all the parameters being relevant to fulfilling a certain task (Norman, 1983). According to Markman and Gentner (2001), such a mental model can be understood as a structure in the long-term memory. If a person has built a nonfunctional mental model, anticipation through mental simulation will lead to false outcome expectancies. Nevertheless, in such a case, a mental model will support a person in action planning, but it is unlikely the outcomes from the real-world performed action will be congruent with the prediction derived from the mental model. Without a functional mental model of their environment and related processes, people will perceive uncertainty and be likely to become unreasonable and emotional (Kaplan and Kaplan, 2009).

Thus, we can conclude that knowledge of stakeholders' mental models regarding resource management is essential to understanding stakeholders' actual management behaviour, their attitudes toward diverse management tools and their intention to participate in management actions.

In this article, we focus on the role of anglers in fisheries management as an example; the stocking of running waters with trout is the management tool under scrutiny. In northern industrialized countries like Switzerland, recreational fisheries dominate the inland fisheries sector (Welcomme and Bartely, 1998; Arlinghaus, Mehner, and Cowx, 2002) and anglers are therefore important stakeholders. In Switzerland, anglers are often actively involved in fisheries management, namely fish stocking. Stocking can be defined as the intentional release of large numbers of fish into natural water bodies. Its main goals are to compensate for human-caused habitat perturbations, to initiate stock recovery after fish-kills or habitat improvements, to retain a species threatened to extinction or to increase harvest (Cowx, 1999; Arlinghaus et al., 2002; Holzer, Peter, Renz, and Staub, 2003). It is a traditional and widespread inland fisheries management tool. From a scientific point of view, stocking is increasingly considered a potential threat to fish conservation and to the sustainability of indigenous fish populations, as it has the potential to harm native fish populations through competition, loss of genetic distinctiveness and spread of diseases and parasites (Cooke and

Cowx, 2006; Lewin, Arlinghaus, and Mehner, 2006). Among anglers, stocking is popular and commonly regarded as the ultimate and immediate solution to declining fishing quality (Molony, Lenanton, Jackson, and Norriss, 2003). A survey among Swiss anglers showed they want to continue current stocking practices or even expand them (Schwärzel-Klingenstein, Lüthi, and Weiss, 1999). However, Burkhardt-Holm et al. (2005) found good indication that anglers generally overestimate the benefit of stocking Swiss streams and rivers with brown trout (*Salmo trutta*).

Recently, von Lindern, Haertel-Borer, and Mosler (submitted; see chapter V) showed that different mental models impact the management preferences of anglers regarding stocking as a tool for resource management. They found two different mental models, one of which represented a more pro-environmental, ecosystem-adequate thinking ('compensatory mental model'), whereas the other illustrated a less pro-environmental and less ecosystem-adequate thinking ('additive mental model') (Figure 1).

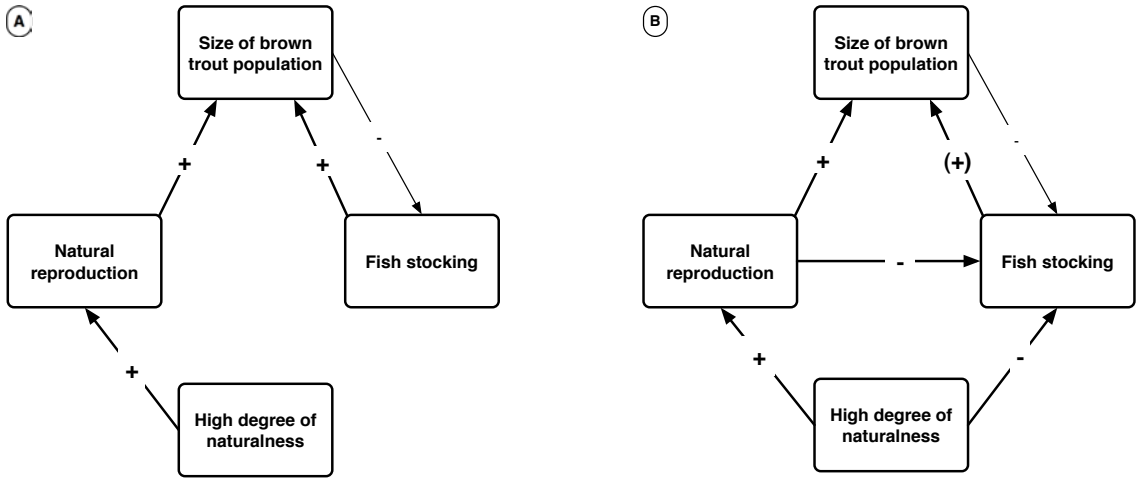

Figure 20 [Figure 1 of chapter VI]. Additive mental model (A) and compensatory mental model (B). The additive model states that natural reproduction and fish stocking impact the size of brown trout populations in an independent, additive way. Stocking is therefore necessary under all habitat and state-of-the-fish-population scenarios. By contrast, the compensatory model links the need for fish stocking to the degree of natural reproduction. Additionally, in comparison to the additive model, the compensatory model attributes less influential power to fish stocking for increasing the brown trout population size.

Even though von Lindern et al. (submitted, see chapter V) found these two types of mental models for Swiss anglers in fisheries management, it is still an open question how mental models impact resource management decisions.

Thus, the aim of our research presented in this article is to show and discuss a model that links mental models to management intention and attitudes toward fish stocking as a management tool. Furthermore, we discuss not only how the analysis of mental models improves the understanding of stakeholders' resource management behaviour, but also how interventions should be applied to promote a more ecosystem-adequate management behaviour. With this approach, we aim to connect resource management to the analysis of mental models as a future research direction in environmental psychology in the sense of Gifford (2009) and Kaplan and Kaplan (2009).

VI.1.2 Mental models in the framework of attitude and intention

The aim of our research was to create a structural model that links the mental models approach to the more commonly used concepts 'attitude toward a behaviour' and 'intention to perform a behaviour'. These concepts are utilised in diverse behaviour-explaining models and theories (Social Cognitive Theory, Bandura, 2004; Theory of Planned Behaviour, Ajzen, 1985, 1991) and play a major role in intervention research (Albarracín, Gilette, Earl, Glasman, and Durantini, 2005). Thus, we decided to use these concepts as our main dependent variables when analysing the effect of mental models for resource management.

In the following, we first describe the eight components or factors with which we built the structural equation model and, second, present the whole model, including the assumed paths from one factor to the other. Due to previous results from qualitative interviews with anglers, we were able to identify these factors as the most important ones for understanding and explaining the anglers' management preferences (von Lindern et al., submitted; chapter V). Figure 2 summarizes the factors we included in our analysis and the assumed influences from each latent factor to the others.

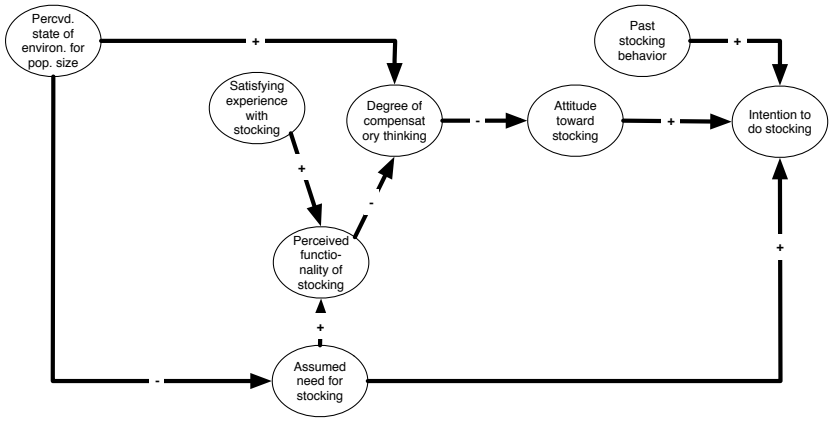

Figure 21 [Figure 2 of chapter VI]. Influence diagram for latent factors impacting intention to do fish stocking. Actual stocking behaviour is not taken into account because we elicited data with a cross-sectional study design. For details on the latent factors, see text below.

VI.1.2.1 Degree of compensatory thinking

The degree of compensatory thinking represents our previous finding, namely, that some Swiss anglers have an additive mental model concerning the effect of fish stocking on the population size and some anglers have a compensatory mental model (see Figure 1). Because we found evidence that compensatory thinking is linked to a more ecologically adequate understanding of river and stream ecosystems than is additive thinking (von Lindern et al., submitted; chapter V), we assume that the degree to which an angler thinks compensatorily has a strong influence on his or her attitude toward stocking. Compensatory thinking means understanding that fish stocking should only be applied under certain circumstances, for example, when natural reproduction is impacted, to acknowledge that diverse key ecosystem factors are interrelated and that fish stocking has the potential to threaten whole fish populations (Cooke and Cowx, 2006; Burkhardt-Holm et al., 2005). Thus, a high degree of compensatory thinking should result in a lower attitude toward stocking.

From our point of view, the latent factor 'degree of compensatory thinking' depends on the assumed functionality of fish stocking and the perceived state of the environment for the size of brown trout populations. If an angler takes into account aspects of the environment such as degree of naturalness (i.e., whether or to what degree a river is pristine), natural reproduction, and river morphology, then the degree of compensatory thinking should be higher. On the other hand, if an angler attributes more functionality to stocking and perceives aspects of the environment as less supportive of the brown trout population size, stocking should be increasingly seen as the method of choice, which should lead to a lower degree of compensatory thinking.

VI.1.2.2 Perceived state of key environmental factors impacting brown trout population size

In previous research, we found that environmental factors such as the degree of naturalness, river morphology, degree of natural reproduction and fish stocking have a large impact on the size of brown trout populations from the anglers' point of view (Haertel-Borer and von Lindern, submitted; chapter IV; von Lindern et al., submitted; chapter V.). Rating the state of these key factors mainly depends on the direct perception of the water body and of experiences with it while fishing. In contrast to other systems, processes in an aquatic ecosystem cannot be perceived directly through observation. For example, the degree of naturalness has no directly, immediately observable effect on natural reproduction and on the actual population size. Furthermore, whether the ecosystem is in a beneficial or hindering state for brown trout populations has to be inferred from long-term observations (such as

population monitoring). Thus, we assume that the rating of the state of key environmental factors impacting brown trout population size derives directly from an underlying mental model for hindering and benefitting aspects of the stream and river ecosystem for brown trout population size, which was created due to long-term experiences and observations made at the angling site or during a fisherman's participation in management actions. We assume that the perceived state of key environmental factors for the brown trout population size impacts the degree of compensatory thinking (see VI.1.2.1) as well as the assumed need for stocking (see VI.1.2.4).

VI.1.2.3 (Satisfying) Experience with fish stocking

According to Norman (1983) and Kaplan and Kaplan (2009), mental models are built through experiences with a target system. When an individual interacts with a given system for the first time, a mental model is created of how the system functions and reacts to specific manipulations. While gaining experience with the system, the mental model will be revised if it does not seem useful for goal achieving. On the other hand, positive experience with fish stocking can be seen as an indicator that the mental model about processes in river and stream ecosystems is valid, or at least functional. Generally, it seems reasonable to assume that the perceived functionality of stocking generates satisfying experiences with stocking. However, in our case, we argue that satisfying experiences instead lead to a perceived functionality of stocking. Functionality of stocking is, like the influence of the degree of naturalness on the population size, usually not immediately and directly observable. Whether fish stocking was successfully increasing the population size can only be assessed later, for example, when conducting population monitoring or through the perception of having more fish (catches) in the river. Therefore, we think that anglers deduce the functionality of stocking from their experiences with stocking. In other words, increasingly satisfying experiences with stocking should correspond to a higher perceived functionality of stocking.

VI.1.2.4 Assumed need for stocking

Mental models are defined as cognitive, simplified representations about real-world systems. They enable a person to plan meaningful action by providing system knowledge and system reaction through mental simulation (Norman, 1983; Kaplan and Kaplan, 2009; Johnson-Laird, 2001, 2006). This means a mental model has to produce statements about the circumstances under which a behaviour is needed and meaningful to achieve a certain goal. The more these statements demand an action, the higher the perceived functionality of this action. When

thinking about fisheries management and fish stocking, a mental model has to provide a stakeholder with information about when fish stocking is needed/useful or in which cases it is not needed, which influences the perceived functionality of stocking.
We assume these mental model-derived need-statements depend on the rating of the perceived state of key environmental factors such as 'degree of naturalness', 'chemical load', 'water quality' and so forth for brown trout populations (see section VI.1.2.2). In other words, if the perceived state of key environmental factors for the brown trout population size is good, the resulting need for fish stocking should be reduced.

VI.1.2.5 Perceived functionality of fish stocking

Besides building a mental model through interaction with a given system, maintaining and enhancing the mental model is crucial for its functionality (Norman, 1983). Kaplan and Kaplan (2009) argued that a mental model contains information about an environment on which people rely for their actions and behaviour. Therefore, a mental model has to be functional to achieve a certain goal. If a mental model turns out to be non-functional, people are likely to revise and change their beliefs about the system until they find a new model that enables them to interact with the system to achieve their goals better (Norman, 1983). Thus, we assume that 'perceived functionality' is a quality criterion for a mental model. If the perceived functionality is high, fish stocking is seen as the method of choice for increasing the brown trout population size. Therefore, a low degree of compensatory thinking (see section VI.1.2.1) will follow from a correspondingly high perceived functionality of stocking. The perceived functionality of stocking should be influenced by the assumed need for stocking and satisfying experiences with stocking, as described above.

VI.1.2.6 Attitude toward stocking

It is widely accepted that a person's attitude toward a behaviour impacts his or her intention to perform that behaviour (Ajzen, 1985, 1991; Schwarzer 2008; de Vries et al., 2005; Bamberg et al., 2007; Bandura, 2004). Kolkman et al. (2005) argued that attitudes are not located inside a mental model and that they can be understood as external input variables for a mental model. By contrast, according to Ajzen (1991), attitude depends on affective and cognitive beliefs, whereas cognitive beliefs are defined as knowledge about a system and assumptions about its reactions. Thus, the concept of cognitive beliefs seems to be very near to the concept of mental models (see section VI.1.1), and, therefore, we assumed that the impact of the degree of compensatory thinking on the intention to do fish stocking is mediated entirely by

the attitude toward fish stocking. We hypothesise that cognitive beliefs are built from the conclusions derived from a mental model. In the case of our study, this means the attitude toward fish stocking will be lower with higher degrees of compensatory thinking and vice versa.

VI.1.2.7 Past stocking behaviour

When aiming at explaining stocking intention, the frequency with which an angler has previously participated in stocking-related actions is an important factor. Diverse studies on behaviour found that already-performed behaviour is a significant predictor of future behaviour and thus of the intention to perform that behaviour (Bamberg et al., 2007; Schwartz and Howard, 1981; Schwarzer, 2008; Albarracín et al., 2005). Therefore, we included the factor 'past stocking behaviour' in our model assumptions.

VI.1.2.8 Intention to do fish stocking

The intention to perform a behaviour is often linked directly to the dependent variable behaviour (e.g., Ajzen, 1985, 1991; Albarracín et al., 2005; Bamberg et al., 2007; de Vries et al., 2005). In our case, we cannot assess stocking behaviour directly because we elicited data in a cross-sectional study design. To take into account the impact on actual behaviour, a longitudinal study design would be needed. Therefore, the intention toward fish stocking is the 'behaviour-nearest' accessible dependent variable.

VI.1.2.9 The structural equation model

Overall, we came up with seven latent factors as important components to predict the 'intention to do fish stocking': (1) 'satisfying experience with fish stocking', (2) 'perceived functionality of fish stocking', (3) 'assumed need for stocking', (4) 'perceived state of key environmental factors impacting brown trout population size', (5) 'degree of compensatory thinking', (6) 'past stocking behaviour' and (7) 'attitude toward stocking'.

In particular, the following hypothesis can be analysed by the structural equation model displayed in Figure 2:

1. The higher the degree of compensatory thinking, the lower the attitude toward fish stocking.
2. The better the perceived state of the environment for the brown trout population size, the less the assumed need for fish stocking.
3. The better the perceived state of the environment for the brown trout population size, the higher the degree of compensatory thinking.
4. The better and more satisfying the experiences with fish stocking, the higher the perceived functionality of stocking.
5. The more perceived functionality, the lower the degree of compensatory thinking.
6. The more need for stocking is assumed, the higher the functionality of stocking.
7. The more need for stocking is assumed, the higher the intention to do stocking.
8. The higher the attitude toward stocking, the higher the intention to do stocking.
9. The more frequently stocking related behaviour was performed in the past, the higher the intention to do fish stocking.

Besides testing this model with a surveyed Swiss angler population, we want to draw conclusions for intervention planning and to discuss the mental models approach in a larger framework.

VI.2 Methods

In a nationwide study, we mailed a paper-and-pencil questionnaire to 3315 Swiss anglers. The questionnaire was constructed to elicit demographics, diverse experiences with fishing and fisheries management (mainly fish stocking), beliefs about ecosystem processes and impact factors on brown trout population size, attitude and intention toward fish stocking and other fisheries management tools as well as pro-ecological orientation and centrality of lifestyle (regarding fishing).

The questionnaire was of considerable length: It consisted of 200 closed and 37 open-ended items on 23 pages. Completing it required approximately one to two hours. Therefore, we used the opportunity to provide participants with feedback on their 'type of angler' as an incentive to enhance the presumably low response rate.

VI.2.1 Measurements

All latent factors were measured by items from the abovementioned nationwide survey study. The details for each latent factor are given in the following.

VI.2.1.1 Degree of compensatory thinking

The degree of compensatory thinking was measured with one item only, which was specially designed to represent the most relevant differences between compensatory- and additive-thinking anglers. The item was worded 'Fish stocking should be done independently of the degree of successful natural reproduction' (F029) and could be answered on a five-point rating scale, ranging from 'totally agree' to 'totally disagree'. (The item numbers 'F029' are provided because they will be used later on when referring to the items and are labelled according to their position in the original questionnaire.) The more an angler disagreed with this statement, the higher the degree of compensatory thinking. Thus, a high value for degree of compensatory thinking means that an angler links the need for fish stocking to key environmental factors such as the degree of natural reproduction, which can be seen as the major difference between compensatory and additive thinking anglers (Figure 1; for details see von Lindern et al., submitted; chapter V).

VI.2.1.2 Perceived state of key environmental factors impacting brown trout population size

This factor was measured by a total of five items. The first four items asked how increases in natural reproduction (F019_3), degree of naturalness (F019_6), fish stocking activities (F019_8) and river morphology (F019_4) impact the size of brown trout populations. The

participants could choose between the three answer categories, ‘disadvantageous to the size of brown trout populations’, ‘does not have an impact on the size of brown trout populations’ and ‘advantageous to the size of brown trout populations’. The fifth item in this factor specified the relation between natural reproduction and stocking and was worded ‘Fish stocking impacts natural reproduction under the condition that there is already successful natural reproduction…’ (F053) with a five-point answer scale, ranging from ‘very positive’ to ‘very negative’. The internal coding of these items means that a high factor value stands for a correspondingly supportive perceived state of the environment for brown trout populations.

VI.2.1.3 Satisfying experience with stocking

Satisfying experience with stocking mainly targets at perceived stocking success and satisfaction with stocking as a management tool. This latent factor is defined by the four items, ‘What do you think? How many fish (in percent) of your angling catch come from fish stocking?’ (F043), ‘Stocking activities I participated in were…’ (four-point rating scale, from ‘very successful’ to ‘not at all successful’) (F046_2), ‘The percentage of stocked fish in my catch means that stocking was…’ (four-point rating scale, from ‘very successful’ to ‘not at all successful’) (F045) and ‘If fish stocking is conducted at your predominantly used water body: How satisfied are you with these stocking activities?’ (five-point rating scale, from ‘very satisfied’ to ‘very unsatisfied’) (F036). Due to the internal coding, a high value for satisfying experience with stocking means that stocking activities were perceived as successful and satisfying.

VI.2.1.4 Assumed need for stocking

The assumed need for stocking was measured by 16 items. All items proclaimed a change in a specific fishery-relevant topic and asked whether fish stocking was needed more or less due to the assumed change. The participants also had the possibility of answering that the indicator did not impact the need for stocking from their point of view. The 16 topics in question were ‘more river restoration’ (F037_1), ‘more natural reproduction’ (F037_3), ‘improved river morphology’ (F037_4), ‘more mature brown trout in stream/river’ (F037_5), ‘increase of degree of naturalness’ (F037_6), ‘increase of human interventions in the river/stream’ (F037_7), ‘increase of brown trout population size’ (F037_8), ‘increased use of hydropower’ F037_10), ‘stricter fisheries regulations’ (F037_11), ‘conservation of local populations’ (F037_12), ‘increased chemical load’ (F037_13), ‘increase in river connectivity (less migration barriers)’ (F037_14), ‘increased water quality’ (F037_16), ‘improved fish health’

(F037_17), ‘increased food availability’ (F037_18) and ‘habitat improvements in general’ (F037_19).

These items were derived from interviews in a preliminary qualitative interview study. They were measured on an ordinal level with the following three answer options: ‘Due to this, stocking is needed more’, ‘This does not influence the need for stocking’ and ‘Due to this, stocking is needed less’. Therefore, these items were treated as categorical data. Because of the internal coding, a high value for the latent factor means a high assumed need for stocking.

VI.2.1.5 Perceived functionality of fish stocking

This latent factor mainly consists of the rating of the degree to which the following seven possible stocking goals could be achieved through stocking: ‘to have more fish for fishermen’ (F038b_1), ‘to compensate for predator-based fish losses’ (F038b_2), ‘to compensate for fishery-based fish losses’ (F038b_3), ‘to compensate for insufficient natural reproduction’ (F038b_4), ‘to compensate for natural variation in population size’ (F038b_5), ‘to be able to catch brown trout in all running waters’ (F038b_6) and ‘to act according to the motto, “Who wants to harvest has to sow first”’ (F036b_7). All these items could be answered on a five-point rating scale, ranging from ‘totally’ to ‘not at all’. The last item for this factor (‘Quitting fish stocking now and still catching fish is, from my point of view…’, four-point rating scale, from ‘feasible’ to ‘infeasible’ [F050]) assessed the perceived functionality on a more general level. Due to the coding of these items, a high value for this latent factor means a correspondingly high perceived functionality.

VI.2.1.6 Attitude toward stocking

The attitude toward stocking was assessed with the following three items: ‘I think fish stocking in rivers/stream with a high degree of naturalness is…’ (F054_1), ‘I think fish stocking in rivers/streams with a low degree of naturalness is…’ (F054_2) and ‘I think fish stocking in general is…’ (F055). The first two items could be answered on a five-point scale, ranging from ‘very good’ to ‘very bad’. The third item was measured using a 10-cm visual analogue scale (Reips and Funke, 2008), ranging from ‘very bad’ to ‘very good’. Because of the internal coding, a high value for the latent factor attitude toward stocking has to be interpreted as a high stocking attitude.

VI.2.1.7 Past stocking behaviour

The past stocking behaviour was measured with four items that elicited the frequency with which an angler was involved in stocking and management related activities. These four items

were worded as follows: ‘How often do you participate in population monitoring?’ (F079_2), ‘How often do you participate in breeding and rearing fish for stocking?’ (F079_4), ‘How often do you participate in fish stocking?’ (F079_5) and ‘How often do you participate in brown trout spawning fisheries?’ (F079_7). All four items could be answered on a five-point rating scale, ranging from ‘always’ to ‘never’. Due to internal item coding, a high factor value has to be interpreted as a high frequency of participation in stocking-related activities.

VI.2.1.8 Intention to do fish stocking

The main dependent factor in our study was assessed with the two items ‘How much are you willing to participate in future stocking activities?’ (F057) and ‘How much do you intend to participate in future stocking activities?’ (F078). Both items could be answered on a 10-cm visual analogue scale. A high value for the latent factor means a high intention to do stocking.

VI.2.1.9 Complete structural equation model

Overall, we constructed a structural equation model that contains the abovementioned latent factors, their indicators and the assumed paths. The complete model is displayed in Figure 3.

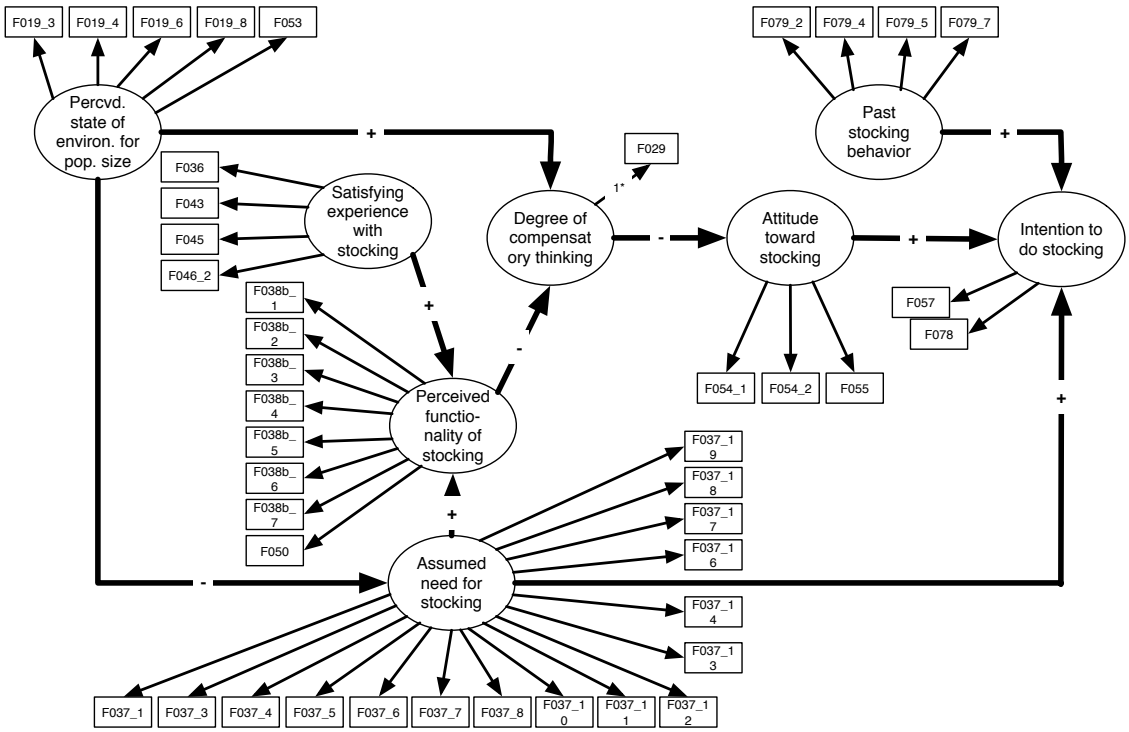

Figure 22 [Figure 3 of chapter VI]. Structural equation model including indicators for latent factors. Assumed measurement errors are excluded for reasons of readability. Degree of compensatory thinking is directly represented by item number F029 (indicated with 1*).

First, we analysed the measurement model by calculating simultaneous confirmatory factor analysis for every latent factor. In a second step, we added the hypothesised paths between the

latent factors. We conducted all statistical analysis using Mplus Version 5.21 (Muthén & Muthén, 1998–2007). With this setup, we wanted to test whether the empirical survey-based data supported our assumptions regarding mental model influences on attitude and intention. Additionally, we performed 3000 bootstrap resamples to compensate for a bias in the original distribution of the surveyed sample and to obtain information about the replicability and stability of the assumed model (Boomsma, 2000).

VI.3 Results

Before we assessed the complete structural equation model, we analysed the underlying factor structure for the eight latent factors included in our model (section VI.3.1). Afterwards, the complete model was analysed (section VI.3.2). We had to exclude 5 cases from our sample of 418 participants because of missing data on every important variable. In total, we used 413 cases for our model analysis.

VI.3.1 Measurement model and factor structure

Overall, the eight latent factors were represented quite well by their presumed indicators. Figure 4 summarises the factor loadings for every latent factor for the total sample (N = 413).

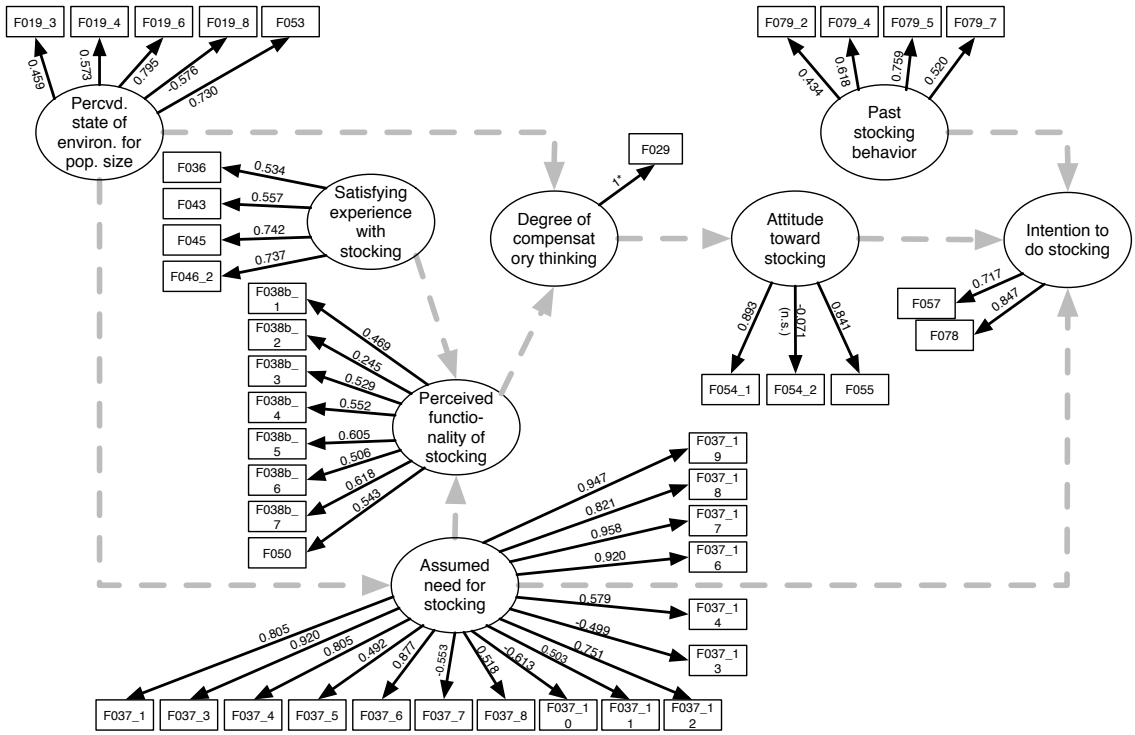

Figure 23 [Figure 4 of chapter VI]. Measurement model for all eight latent factors. The factor loadings were calculated by a multiple confirmatory factor analysis with Mplus Version 5.21. All factor loadings are standardised values; the loading for indicator F029 was fixed to 1. The coefficient paths are greyed out because they are calculated in a later step).

With factor loadings ranging from 0.24 to 0.95 and at least two indicators per latent factor greater than 0.6, most latent factors were represented very well by their indicators. 'Attitude toward stocking' had factor loadings greater than 0.84 ($p < .000$) for two of the three indicators, while the loading of the third indicator was not significant ($p = .212$) and very low (-0.071). Nevertheless, we retained this indicator in our model for theoretical reasons. The only latent factor that was just fairly represented by its indicators was 'perceived functionality of stocking', with factor loadings ranging from 0.24 to 0.62. However, all indicators (besides F054_2) had a significant influence ($p < .000$) on the latent factors.

VI.3.2 Structural equation model

After ensuring the latent factors were well represented by their indicators, we included the hypothesised paths between the latent factors. The results are displayed in Figure 5.

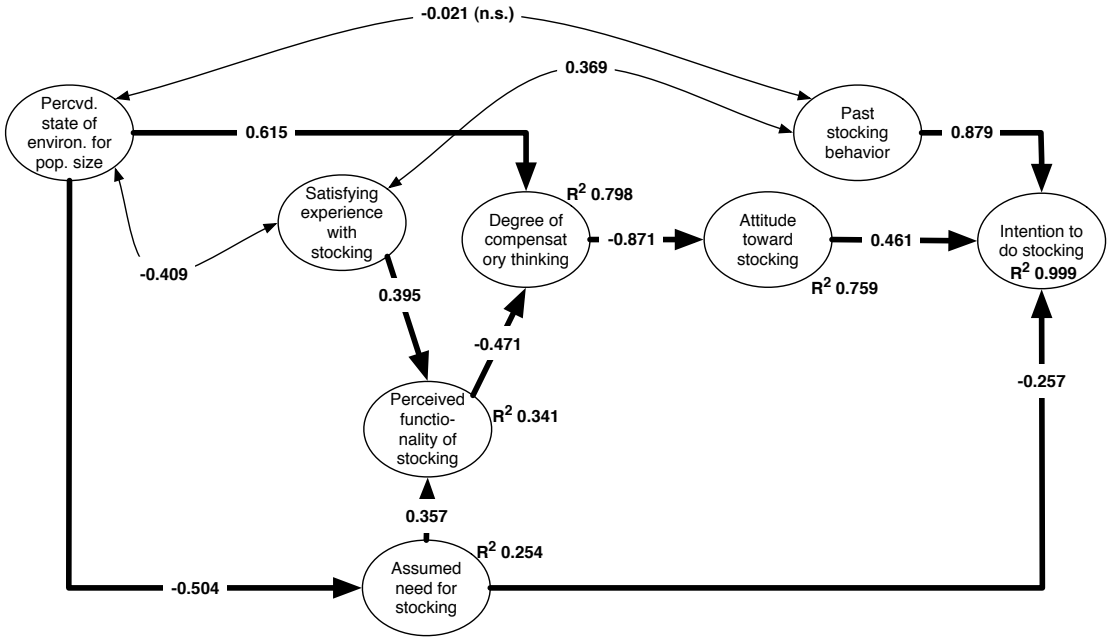

Figure 24 [Figure 5 of chapter VI]. Structural equation model with standardized path coefficients and explained variance ($\chi^2 = 343.055$, df = 133, $\chi^2/df = 2.58$, CFI = 0.921, TLI = 0.951, RMSEA = 0.062). (n.s.) = not significant at $p < .05$.

The model fit indices ($\chi^2 = 343.055$, df = 133, $\chi^2/df = 2.58$, CFI = 0.921, TLI = 0.951, RMSEA = 0.062) for the whole model were acceptable according to Hu and Bentler (1999), which means the empirical data fit the model well and all assumed paths were significant ($p \leq .000$). Additionally, Mplus calculates the correlation for the independent exogenous latent variables by default (Muthén and Muthén, 1998–2007). As a result, we found a

significant correlation between ‘past stocking behaviour’ and ‘satisfying experience with stocking’ as well as a negative medium correlation between ‘satisfying experience with stocking’ and ‘perceived state of the environment for the brown trout population size’, which will be discussed later (section VI.3.2.1 and section VI.4). However, when looking in detail at the assumed paths between the latent factors, we were not able to confirm every hypothesised influence. In the following, we summarise the results for each assumed path and its supposed influence.

We hypothesised that a satisfying experience with fish stocking would lead to a correspondingly high perceived functionality of stocking. The path coefficient from ‘satisfying experience with stocking’ to ‘perceived functionality of stocking’ (0.395, $p < .000$) supports our assumption. Interestingly, the correlation between ‘satisfying experience with stocking’ and ‘perceived state of the environment for the brown trout population size’ ($r = -0.409$, $p < .000$) was negative, which means that good and satisfying experiences correlate with the perception of a state of the environment to the brown trout population size. This issue will be discussed later in section VI.4. The correlation between ‘satisfying experience with stocking’ and ‘past stocking behaviour’ ($r = 0.369$, $p < .000$) was not surprising, since an angler had to be involved in stocking activities to actually have any experiences with it.

The path coefficient of -0.504 ($p < .000$) supports our hypothesis that a perceived state of the environment that is correspondingly advantageous to the brown trout population size leads to a lower assumed need for fish stocking. Furthermore, the perceived state of the environment for the size of brown trout populations directly impacts the degree of compensatory thinking (0.615, $p < .000$), which means the perception of the state of key environmental factors influences whether an angler has an additive or compensatory mental model regarding stocking.

We expected that a higher assumed need for stocking would increase the perceived functionality of stocking as well as the intention to do stocking. These hypotheses were only partially confirmed by the path coefficients. While the path coefficient from ‘assumed need for stocking’ to ‘perceived functionality of stocking’ was as we hypothesised (0.357, $p < .000$), the negative path coefficient (-0.257, $p < .000$) to ‘intention to do stocking’ rejected our assumption. Thus, we concluded that a high assumed need for stocking indeed increases the perceived functionality of stocking, but lowers the intention to participate in stocking activities. A possible explanation will be discussed in detail in section VI.4.

The perceived functionality of stocking had a negative impact (-0.471, $p < .000$) on the degree of compensatory thinking. Thus, this result supports our assumption that the more functionality an angler sees in doing stocking, the lower his or her degree of compensatory thinking.

From a theoretical point of view, the degree of compensatory thinking should have a very high influence on the attitude toward fish stocking because the degree of compensatory thinking derives from the underlying mental model. The high path coefficient (-0.871, $p < .000$) from 'perceived degree of compensatory thinking' to 'attitude toward stocking' supports this assumption. Thus, we can conclude that anglers with more compensatory thinking have lower attitudes toward stocking. In other words, the more an angler agrees that fish stocking should be done independently of the degree of natural reproduction, the higher the attitude toward stocking.

As expected, the path coefficient from 'attitude toward stocking' to 'intention to do stocking' was positive (0.461, $p < .000$), which means that a high attitude toward stocking increases the intention to participate in stocking. This finding is congruent with well-known theories from social psychology, for example, the theory of planned behaviour (Ajzen, 1985, 1991) or Bandura's (2004) social cognitive theory.

We expected that the frequency with which stocking-related behaviour was performed in the past would impact the intention to do stocking. The path coefficient from 'past stocking behaviour' to 'intention to do stocking' was very high (0.879, $p < .000$) and thus congruent with our expectation. This result supported our hypothesis that an angler would develop a stronger intention to do stocking if he or she was more involved in stocking-related activities in the past. Additionally, it emphasises the role of past behaviour in predicting future behaviour.

VI.3.3 Amount of explained variance

Besides empirical support for the hypothesised paths in the structural equation model, we found high amounts of explained variance for the endogenous latent variables in the structural equation model (Figure 5).

For intention to do stocking, 99.9% of variance was explained by the three latent factors: 'past stocking behaviour', 'assumed need for stocking' and 'attitude toward stocking', which is remarkably high. This means almost all variation in the intention to do stocking in our sample could be explained by our model assumptions. The amount of explained variance for the degree of compensatory thinking (79.8%) was quite high as well. Therefore, we can conclude

that the main difference between additive- and compensatory-thinking anglers (agreement or disagreement with whether fish stocking should be conducted dependently on or independently of the degree of natural reproduction) can be predicted very well according to the underlying mental model about the functionality for fish stocking and the perceived state of the river and stream ecosystem. For the remaining three endogenous latent factors, the amount of explained variance was quite high as well: For 'attitude toward stocking', our model explained 75.9% of variance, for 'perceived functionality of stocking', 34.1%, and for 'assumed need for stocking', 25.4%.

VI.3.4 Replicability and stability of the model

We requested 3000 bootstrap resamples using Mplus Version 5.21 (Muthén and Muthén, 1998–2007). From these 3000 requested bootstrap draws, 1039 were actually performed. As a result, the RSMEA dropped to 0.000, and we received only a marginal change in significance levels for two path coefficients ('assumed need for stocking' to 'intention to do stocking' from $p < .000$ to $p = .002$; 'satisfying experience with stocking' to 'perceived functionality of stocking' from $p < .000$ to $p = .003$). Additionally, there was a similar change in the significance levels for four factor loadings in the measurement model (item F054_2, as the indicator of 'attitude toward stocking', increased from $p = .212$ to $p = .277$; item F038b_2, for 'perceived functionality of stocking', increased from $p < .000$ to $p = .004$; both F019_3 and F019_4, as indicators for 'perceived state of the environment for the brown trout population size', increased from $p < .000$ to $p = .001$). Thus, nothing essential changed in the model, which can be interpreted as a good indicator of its robustness and replicability (Boomsma, 2000).

Overall, according to the results of our model analysis, we found evidence of a high impact of mental model-derived statements (such as that for the degree of compensatory thinking) and the perceived functionality of a mental model on the attitude toward fish stocking and the intention to participate in fish stocking activities. Thus, we found evidence of the importance of mental models for resource management.

VI.4 Discussion

In general, with the analysis of the structural equation model and the linkage between the mental models approach and commonly used constructs of social and environmental psychology, we were able to find empirical support for the majority of our hypotheses. The results were as we expected, except for the negative path coefficient from 'assumed need for stocking' to 'intention to do stocking'. Nevertheless, there are some further results that need to be discussed because they may impact future research or their meaning needs to be clarified.

First, 'satisfying experience with stocking' showed a significant negative correlation ($r = -.409$, $p < .000$) with an advantageous 'perceived state of the environment'. A possible explanation for this negative correlation might be the following: If an angler is satisfied with stocking, he or she assumes that stocking was the right management decision. Satisfaction with stocking means the angler thinks there are more fish in the water body because of stocking. A prerequisite for this belief is that the water body was not able to provide an adequate fish population through natural reproduction (or the angler believes that, with fish stocking, the population can be increased even further). Therefore, the water body has to be in a disadvantageous state for natural reproduction and thus for an adequate size of brown trout populations, which means it has a rather low degree of naturalness. Nevertheless, it may meet the requirements to support brown trout that already dwell in the river. This interpretation is in line with the finding that the attitude toward fish stocking in rivers with a low degree of naturalness had no significant impact on the latent variable, 'attitude toward stocking' (see section VI.3.1, Figure 4). Thus, the degree of naturalness can be understood as a moderator for the attitude toward stocking as well as for the correlation between 'satisfying experience with stocking' and 'perceived state of the environment for the brown trout population size'.
Second, in contrast to our hypothesis, the assumed need for stocking had a negative impact on the intention to do stocking. At first glance, it would be reasonable to assume the exact opposite: If there is a need, the intention should rise. Yet, when taking into account that we assessed the assumed need with a total of 16 indicators, it is possible that we drew the anglers' attention to more need-indicating aspects than they usually pay attention to. However, we found evidence in the literature that too much information could lead to decreasing activity in general. Dörner (2000) pointed out that participants in his experiments reached their cognitive capacity when dealing with complex systems, which often led to failure in planning and decision making. Additionally, Milgram (1970) reported that the

human capacity for information processing is overstrained when confronted with too many stimuli, which calls for coping strategies. One coping strategy could be showing disengagement in activities (Milgram, 1970), which is comparable to a lowered intention to perform a behaviour. Furthermore, Kaplan, Kaplan, and Ryan (1998) found that, if there is too much information in maps, people are discouraged from using these maps or decide to avoid the whole area due to a similarly overwhelming anticipated complexity. In summary, these findings support the assumption that 16 indicators of the need for stocking might be perceived as overwhelming, which would result in a lower intention. In this framework, the negative path coefficient makes sense: If there are too many indicators demanding stocking, a very high self-efficacy in combination with a high perceived functionality is needed to deal with all indicators. Otherwise, the indicators signify that even stocking will not be enough to compensate for all the negative indicators. Thus, the more indicators demand stocking, the less likely it is that stocking can compensate for all of them and therefore the intention to do stocking will decrease.

In general, with the constructed structural equation model, we were able to show a reasonable model of how mental models contribute to building an attitude toward a behaviour and how the intention to perform a behaviour is impacted by underlying mental models.

Therefore, it can be concluded that analysing mental models gives insight into intention and attitude building. Furthermore, Swiss recreational fishermen depend to a large degree on their mental models as far as their attitudes and their intentions. Given these results, we also found evidence supporting Kaplan and Kaplan's (2009) emphasis of the role of analysing mental models in future research directions of environmental psychology.

VI.5 Limitations

Our results showed how mental models impact intention and attitude toward fish stocking in fisheries management for Swiss recreational fishermen. Nevertheless, this study has a few limitations.

First, we had a relatively small sample of 413 Swiss recreational fishermen. As a result, we cannot claim generalizability to even the population of Swiss anglers. It is possible that only very engaged and motivated anglers responded to our questionnaire because completing it was very demanding. On the other hand, it is reasonable to assume that these motivated and engaged anglers actively participate in decision-making regarding fisheries management in their fishing clubs. Another limitation targets the results received for the measurement model. All latent variables were well represented by their supposed indicators except for the latent variable, 'perceived functionality of stocking'. Only two out of eight factor loadings were above 0.6, which means there is some uncertainty coming from measurement errors for the latent variable, 'perceived functionality of stocking'. We can conclude that the measurement of perceived functionality needs improvement so that the functionality can be assessed more precisely in future research. This improvement might be achieved through a better operationalization and/or through changes in the item wording and selection.

A further limitation to this study is that the degree of compensatory thinking was elicited by only one indicator. However, this indicator (item F029, see section VI.2.2.1) was specially designed to best represent the differences between additive and compensatory thinking; on the other hand, it is a reduction of the complex and manifold differences between additive- and compensatory-thinking anglers that we found in our previous research (Haertel-Borer and von Lindern, submitted; chapter IV; von Lindern et al., submitted; chapter V). It would be more favourable to construct a scale to assess the degree of compensatory thinking more reliably and with respect to all of its aspects. Aside from this, the reduction worked well in our structural equation model.

The last limitation deals with the fit indices for the structural equation model. According to Hu and Bentler (1999), the model fit is good and acceptable, but the RMSEA in particular could be lower for a better model fit. Perhaps the abovementioned improvement to measuring the perceived functionality of stocking would suffice to lower the RMSEA below 0.05, which would represent a better model fit. Nevertheless, the resamples performed due to the 1039 bootstrap draws showed the model is quite robust, and we were able to explain a vast amount of variance for the attitude toward and the intention to do stocking despite the abovementioned limitations.

VI.6 Future Research and Implications for Planning Interventions

We were able to show how mental models influence anglers' attitude and intention toward fish stocking as a fisheries management tool. Thus, we are convinced that analysing mental models in general contributes to environmental and social psychological research because it allows a deeper understanding of people's behaviour and decision-making processes. Besides enhancing the global understanding of cognitive processes and attitude building, the mental models approach offers a perfect field for planning, tailoring and applying interventions (for tailoring interventions in general, see Mosler and Martens, 2008). This would be a good approach in fisheries management in particular, which can be illustrated with the following two examples. First, an important result of our analysis was that the perception of the state of environmental factors influences whether an angler thinks compensatorily or additively. For intervention planning, this means that teaching anglers skills to rate the environment should enhance the degree of compensatory thinking. This is congruent with comments given by interviewed anglers, where one reason mentioned for the degree of natural reproduction not being taken into account when planning fish stocking was that anglers think of assessing and rating it as almost impossible due to unobservable processes in the stream and river ecosystem. Thus, this perceived barrier might be lowered through training and enhancing environmental rating skills.

Second, a possible explanation for the anglers' intention to do stocking (see section VI.1.1) may be that stocking has generally been pursued uncritically in the past, with only little scientific evaluation of its success or failure (Cowx and Gerdeaux, 2004; Welcomme and Bartley, 1998) or despite proven failure (Cowx, 1999; Lewin et al., 2006).

According to our structural equation model, the most reasonable intervention would be to question the perceived functionality of stocking when targeting changing anglers' attitude toward stocking and their intention to stock. This could be achieved through so-called mark–recapture experiments, where the stocked fish are marked prior to stocking and the stocking success is evaluated over time by periodic recaptures. The results in terms of contribution of stocked fish to the overall stock and/or survival of stocked fish should then be given as feedback to the anglers, or, ideally, the anglers should be actively participating in the mark–recapture experiments (thus, there might be a chance that their rating skills for the environment can be trained, too). If anglers really overestimate stocking success as Burkhardt-Holm et al. (2005) indicated, participation in this stocking success assessment should (1) lower the anglers' satisfying experience with stocking and (2) decrease the perceived functionality of stocking, which will lead to a higher degree of compensatory

thinking and, finally, to a lower attitude toward stocking and stocking intention. Thus, with anglers' lower attitude toward and decreased intention to do stocking, it becomes more likely that management alternatives will be considered and tested.

We are convinced this approach to tailoring and planning interventions is very promising for changing behaviour. If people really rely on their mental models in everything they do, as Kaplan and Kaplan (2009) pointed out and we showed in our study of Swiss recreational fishermen, we can hypothesise that fitting interventions to pre-existing mental models in the target group should have a major impact on the target group's beliefs and thus on their attitudes, intentions and, finally, on their behaviour. From our point of view, future research in environmental psychology and intervention planning will benefit from focusing on tailoring interventions according to the target group's mental models.

VII. Applying Mental Models Derived Interventions[5]

Abstract

Analysing mental models is a promising approach for tailoring interventions, e.g. aiming at promoting a more sustainable and pro-environmental resource management among stakeholders. In the present study, we applied mental model derived tailored interventions to change the beliefs, attitude, and intention of members of six Swiss recreational fishing clubs regarding fish stocking as a fisheries management tool. Besides conducting biological stocking success controls together with fishing clubs in their streams, we elicited the intended change in the psychological relevant dimensions with recurring surveys. Although no significant changes could be identified over the course of our project, we identified tendencies of change in the intended direction. In total, four out of six fishing clubs agreed on changing their management practice due to results of the stocking success controls.

Keywords:

Mental model, intervention, resource management, fisheries management

[5] This chapter is designed as a stand-alone manuscript for publication. It is currently in preparation for being submitted. Authors: Eike von Lindern, Susanne S. Haertel-Borer, Hans-Joachim Mosler.

VII.1 Introduction

Recent studies on fisheries management indicated that the way running waters are managed might not be always sustainable or pro-environmental. One management tools under criticism is fish stocking (hereafter called stocking). It can be understood as the intentional release of large numbers of fish into the wild. Main motives are mitigation for human-caused habitat perturbations (e.g. lack of spawning sites), restoration (e.g. stock recoveries after fish-kills or habitat improvements), conservation (e.g. retaining populations threatened by extinction), and harvest enhancement (Cowx, 1999; Arlinghaus et al., 2002; Holzer , Renz, and Staub, 2003; Baer, Hanfland, Lemcke, Meyer, and Zahn, 2007). Fisheries ecologists (e.g. Cooke and Cowx, 2006; Lorenzen, 2005) have pointed out that stocking has the potential to threaten fish conservation and the sustainability of indigenous fish stocks through increased competition (between and within fish stocks), loss of genetic distinctiveness (e.g. through hybridization), and through the spread of diseases and/or parasites. Furthermore, the effectiveness of stocking in means of its contribution to the overall stock size is questionable (Lorenzen, 2005; Cooke and Cowx, 2006).

In Switzerland, as in many other countries, stocking is widespread and conducted in large numbers. For example, 88% of almost 3000 Swiss stream and river stretches, surveyed by the Swiss Federal Office of the Environment (www.bafu.admin.ch), are stocked. Stocking success is rarely assessed (Burkhardt-Holm, Giger, Güttinger, Ochsenbein, Peter, Scheurer, Segner, Staub, and Suter, 2005). Despite this lack of proven success or failure, a survey among Swiss anglers revealed that they want to continue doing stocking or even plan to increase it (Schwärzel-Klingenstein, Lüthi, and Weiss, 1999). This is in accordance with the notion by Burkhardt-Holm et al. (2005) that stocking success is often overestimated by anglers, which means that they attribute more power to stocking to contribute to the overall stock size, e.g. by assuming a very high share of stocked fish in their catch. Anglers often dominate the inland fisheries sector in industrialised countries (Welcomme and Bartely, 1998; Arlinghaus, Mehner, and Cowx, 2002) and can be considered as being main stakeholders, who are directly and actively involved into fisheries management, e.g. by conducting stocking (e.g. Cooke and Cowx, 2006; Lewin, Arlinghaus, and Mehner, 2006; Granek et al., 2008). When aiming at promoting sustainable and pro-environmental fisheries management, it therefore seems that anglers as main stakeholders and their beliefs about stocking are the favoured target population for applying intervention.

Analysing mental models is a promising approach for understanding why people do what they do (e.g. Kaplan and Kaplan, 2009; Breakwell, 2001; Kolkman, van der Veen, and Geurts, 2007; Atman, Bostrom, Fischhoff, and Morgan, 1993; Morgan, Fischhoff, Bostrom, and Atman, 2002). In a Swiss-wide survey study, Haertel-Borer and von Lindern (submitted, chapter IV), von Lindern, Haertel-Borer, and Mosler (submitted, chapter V) and von Lindern and Mosler (submitted, chapter VI) have shown that Swiss anglers differ in their mental models regarding fisheries management, stocking and its impacts on the stock size of brown trout (*Salmo trutta*, hereafter called trout). They identified an additive and a compensatory thinking model among the surveyed angler population. The additive model basically states that stocking should be conducted independently from natural reproduction of trout, while the compensatory thinking anglers linked the need for stocking to the degree of successful natural reproduction. Additionally, the compensatory thinking anglers considered more factors from the environment as influencing stocking than the additive thinking ones did. They further scored significantly higher on the new ecological paradigm scale (Dunlap, van Liere, Mertig, and Jones, 2000; adapted to the fisheries context by Arlinghaus, 2004 and Arlinghaus and Mehner, 2005) than the additive-thinking anglers (von Lindern et al., submitted, chapter V). Consequently, their attitude towards stocking was significantly lower than it was for additive thinking anglers. Thus, von Lindern et al. (submitted, chapter V) and von Lindern and Mosler (submitted, chapter VI) concluded that promoting a more pro-environmental fisheries management could be achieved by impacting typical additive structures in the mental models through tailored interventions (for details on tailoring interventions see Mosler and Martens, 2008) and by fostering typical compensatory mental model belief structures.

Based on the above-mentioned findings, we pursued the question whether mental models derived tailored interventions are suitable for changing additive mental models to compensatory mental models, thus promoting a more pro-environmental fisheries management. To address this question, we have designed a participative field experiment, where we conducted stocking success controls with members from participating fishing clubs. We provided feedback on the stocking success by distributing stocking success reports among the anglers of each fishing club and discussed the results of the biological stocking experiment with them in detail in a workshop (again, for each fishing club separately). The complete study design and details on both reports and the workshop will be given in section VII.2. In particular, we addressed the following hypotheses:

1. Mental model based intervention is suitable to change additive to compensatory beliefs
2. The participation of anglers in stocking success control experiments lowers their perceived functionality of stocking. This means that the share of fish derived from stocking in the catch from the anglers' point of view adapts according to the stocking success results. We expect a stronger influence on the perceived functionality from explaining and discussing stocking success results (e.g. in a workshop) than from only reporting these results (e.g. in a stocking result report).
3. Intention to do stocking and the attitude towards stocking changes according to changes in the anglers' mental model. An increase in the degree of compensatory thinking should lead to a decrease in the attitude towards stocking and in the intention to do stocking. Vice versa, a decrease in the degree of compensatory thinking should increase the intention and attitude, while no change in the degree of compensatory thinking should result in a stable attitude and intention regarding stocking.

According to Kaplan and Kaplans' statement, that "they [the people] rely on them [their mental models] in everything they do" (Kaplan and Kaplan, 2009, p. 330), we assume that tailoring interventions according to mental models of the target population should have an immense impact and should be very powerful in its effect, namely changing additive to compensatory belief structures.

VII.2 Methods

This section first describes the study design. In a second step, it is outlined how interventions were tailored according to the identified mental models as well as which psychological dimension we wanted to target at with which intervention. In the last part, the measurements for the intervention-effect are described.

VII.2.1 Study design

The study was designed as a longitudinal panel study. We recruited six Swiss fishing clubs in different parts of Switzerland. The requirements for the fishing clubs to participate were that

- they fished in and were involved in the management of trout streams,
- the streams under scrutiny were stocked regularly and in the same manner for the last years,

- stocking was conducted with trout fingerlings in late summer/autumn and aimed at compensating real or perceived deficiency of natural reproduction of trout,
- there were no prior stocking success controls,
- they were interested and willing to participate in both field work associated with the success controls and in recurring surveys.

The fishing clubs were informed about the project background and its design and that we wanted to give them repeated feedback on the project progress and its results. It was clearly outlined that during the project they should conduct stocking as they were used to do it (with the exception that the fish stocked would be externally marked) and that volunteers from the fishing club were needed to repeatedly participate in fieldwork. Additionally, they were informed that we were particularly interested in their beliefs about and experience with stocking, trout stocks and processes in the stream and river ecosystem in general. The presidents of all six fishing clubs agreed to these conditions in preparative meetings and the fisheries scientists involved in this project informed the fishing club members about the project details. Thus, the fishing clubs were instructed that they were mend to respond to recurring surveys (four in total) and to participate in a workshop at the end of the project (so there were a total of six workshops, one for each fishing club).

Overall, the project was on the one hand designed as a mixture of a participative program, where the fishing club members should be actively involved in stocking and the stocking success controls. On the other hand, as a feedback on the stocking success, we provided the anglers with information about stocking success in their primarily managed fishing clubs' river in two interim reports (one fishing club received only one interim report: due to weather conditions the spring survey was not possible) and in a final report at the end of the project, followed by a workshop, where we discussed the final results with the anglers. Details on the report, the workshop and the recurring survey as well as on the stocking success controls are given in the following subsections (VII.2.2.1. – VII.2.2.3). Figure 1 summarises the study design and gives information about the project timeline.

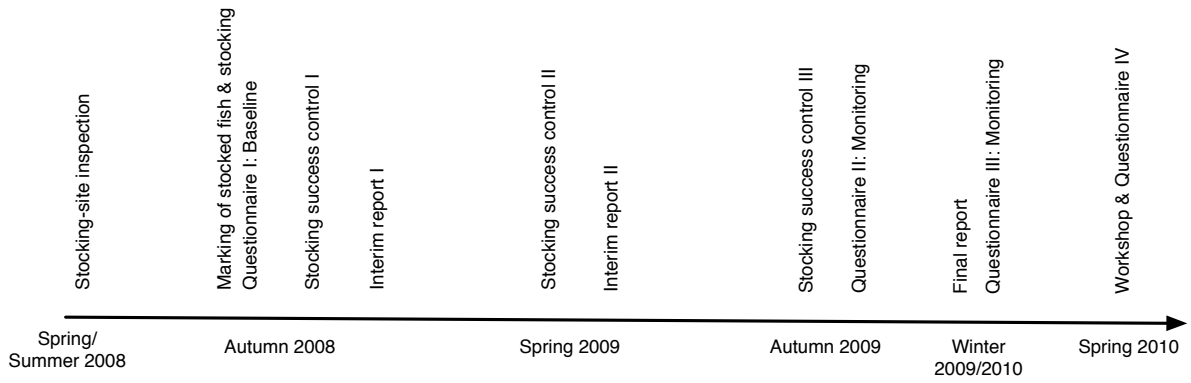

Figure 25 [Figure 1 of chapter VII]. Project timeline. The exact timing for each participating fishing club depended on several aspects, e.g. weather and water level conditions for stocking success controls.

VII.2.2 Intervention-planning based on mental models

In previous research, we found that the degree of compensatory thinking is directly influenced by the perceived functionality of stocking and the perceived state of the environment for the size of trout stocks and that the degree of compensatory thinking is a strong influencing factor for the attitude towards stocking (von Lindern and Mosler, submitted, chapter VI). This was congruent with findings from literature, where the functionality of a mental model is seen as a quality criterion: a mental model is functional, when it enables a person to achieve a certain goal when interacting with a certain system (e.g. Norman, 1983; Kaplan and Kaplan, 2009). Otherwise, action will lead to failure and the mental model will be revised, until it is functional again for goal achieving (e.g. Norman, 1983; Johnson-Laird, 2006). Furthermore, Kaplan and Kaplan (2009) have pointed out that a functional mental model enables people to act reasonable, while a non-functional or insufficient mental model promotes emotional and unreasonable behaviour. Thus, targeting the functionality of additive mental models, namely that stocking is always increasing the size of trout stocks and that it should not depend on the degree of natural reproduction (von Lindern and Mosler, submitted, chapter VI; von Lindern et al., submitted, chapter V) should be a primary target for intervention. Additionally, we found that the perceived functionality depends on experience made with stocking as well as on the assumed need for stocking. Based on these results we can be more precise regarding intervention planning: intervention suitable for changing additive mental models to compensatory mental models has to question that stocking should be done independently from natural reproduction and always contributes positively to the size of trout stocks. At the same time, the compensatory beliefs have to be fortified, that stocking is more functional and successful when depending on environmental factors like the degree of natural reproduction.

In particular, our study was designed to meet these requirements for mental models based intervention by actively involving the anglers in the stocking and success control processes (section VII.2.2.1), providing them with feedback on the stocking success through the interim and final reports (section VII.2.2.2) and discussing the results in the workshop (VII.2.2.3), which will be presented in the following in more detail. The interventions were applied separately for each fishing club.

VII.2.2.1 Participation in stocking success control experiments

Stocking success is rarely assessed in Switzerland (Burkhardt-Holm et al., 2005). Anglers therefore usually have no direct feedback whether stocking was successful in increasing stock sizes and catches or not. They have to infer from their beliefs to which degree stocking was successful. By conducting stocking success experiments, the anglers can directly experience to which degree stocked fish contribute to the stocked age class of fish and thus ultimately to the overall stock size. Thus, we marked the stocked trout (fingerlings) by clipping the adipose fin, which is a common marking method in fisheries biology (Johnson and Ugedal, 1988). Figure 2 displays the differences between a marked and an unmarked trout.

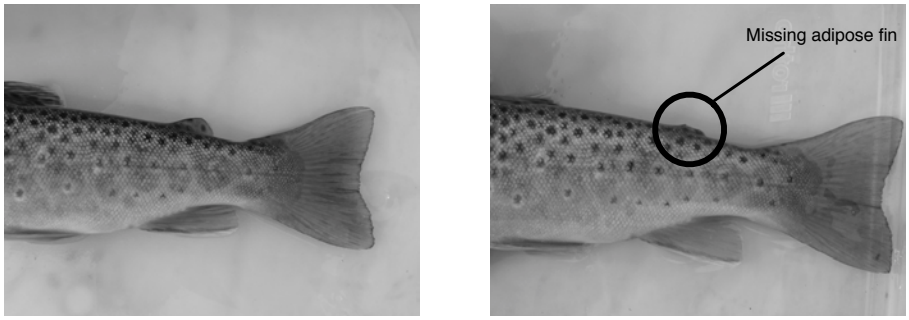

Figure 26 [Figure 2 of chapter VII]. Stocked trout were marked by clipping the adipose fin, so that they could be identified later on and discriminated from trout derived from natural reproduction. Left picture shows trout before adipose fin clipping, right after adipose fin clipping.

The marking was led by and supervised by a fisheries ecologist and the participating anglers were trained to help and to discriminate marked from unmarked trout. The trout were released in their target rivers after being marked. We than conducted together with the fishing clubs three trout population surveys in the stocked rivers (late autumn 2008 = shortly after stocking, spring 2009 and autumn 2009), and thus followed the stocked fish over a time period of one year. All marked and unmarked fish caught in a pre-defined river stretch were counted, and

measured. By involving the anglers in this process, we wanted to provide them with direct experience of how the stocked fish contribute to the overall stock size compared to trout from natural reproduction. By this, we wanted the anglers to directly experience the stocking success so that they do not have to infer it from their beliefs about the efficiency of stocking.

VII.2.2.2 Feedback on stocking success

Because only a few anglers from each participating fishing club could (or wanted to) participate in the fieldwork and the stocking success results can only be interpreted after data processing, we prepared an interim report after each trout-population monitoring and the final report after the last monitoring in autumn 2009. The reports included information about the overall stock density, the density of fingerlings from natural reproduction and from stocking, the fraction of stocked trout in the respective age class that was stocked and how this changed over time. Additionally, an assessment of the river (whether it was in a good, near natural state or not, discharge and temperature conditions) based on a standardised Swiss survey method (Schager and Peter, 2004) was included.

The reports were sent to the fishing club presidents who have been instructed and agreed to distribute them among their club members. Each fishing club did only receive the results for their primarily managed river only, because different stocking results were expected due to the differing habitat and environmental conditions.

By providing the fishing club members with these information, we wanted to ensure that everyone in the fishing club received the stocking success control results, thus learning whether stocking was successfully contributing to the stock size (that means being functional) or not.

VII.2.2.3 Workshop

The workshop was scheduled at the end of the project separately for each fishing club. It was designed as the main intervention instrument. The results from the success controls were presented and both explained to and discussed with the participating anglers, so that ambiguities, misunderstandings or different interpretations could be clarified.

Additionally, we presented the finding of a compensatory and additive belief structure among Swiss anglers (referring to the Swiss-wide survey) and explained to the workshop participants, why the compensatory belief structure is the more adequate view of the stream and river ecosystem. Furthermore, we confronted the participants with the strongest

differences between additive and compensatory thinking anglers, based on a nationwide survey study, and presented to them the results from their fishing club. Thus, we wanted them to think about their conceptions regarding stocking, natural reproduction and the size of trout stocks. In combination with the biological results from their streams and the explanation of the compensatory mental model we aimed at initialising a shift in the participants' mental models from additive toward compensatory beliefs. Furthermore, we initiate discussion among the participating anglers by presenting them four statements and asked them whether they agree or disagree to these statements and why they do so (for details on the statements see section VII.2.3 Measurements).

With this intervention design we followed Breakwells (2001) recommendation that mental models can be changed by giving the participants the informational and motivational basis for rejecting the unwanted (in our case the additive model) and favouring the new model (in our case the compensatory model). To consolidate the compensatory belief structure, we discussed with the workshop participants what they will try to change and how they will proceed with stocking in the future.

VII.2.3 Measurements

This section focuses on the applied measurements. In VII.2.3.1 it is described, how the stocking success controls were conducted and measured. Because there are no psychological measurements in this subsection, it will only describe very briefly how the biological measurements were recorded. Subsection VII.2.3.2 describes all relevant measurements regarding the impact of the interim and final report, while in subsection VII.2.3.3 the data collection in the workshop is detailed.

VII.2.3.1 Stocking success controls

The stocking success was assessed by so called mark and recapture experiments (Williams, Nichols, and Conroy, 2002). All stocked fish were marked by adipose fin clipping (see figure 2, above). For the measurement of stocking success, the population size of trout in stocked rivers was monitored by electro-fishing at three time points (autumn 2008, spring 2009, autumn 2009) to count the share of marked (which means stocked) trout in the trout population dwelling in the river. For every river, there were three to four survey sites, which were assessed separately. The results were analysed by fishery biologists and rated using the Modulstufenkonzept Methode Fische Stufe F" [Method for assessing running waters; Fishes Level F (covering a large area)] (Schager and Peter, 2004). Figure 3 gives some impressions from the fieldwork.

Figure 27 [Figure 3 of chapter VII]. Impressions from stocking success controls. Warning signs (A) were set up along the river stretches that were surveyed by electro-fishing (B). The caught fish were measured and counted at improvised field-stations (C).

VII.2.3.2 Impact of interim report and final report

Overall, the members of the six fishing clubs received three questionnaires before the workshop, and one immediately after the workshop (see VII.2.3.3 Workshop). The first questionnaire (T0) was a very long baseline questionnaire and mostly identical with the one used in the Swiss-wide survey study (von Lindern et al., submitted, chapter V; see also chapter III.3, III.4 and the appendix XIV.2 and XIV.3), which thematised diverse topics regarding fishing experience, demographics, beliefs about processes in the ecosystem and information about the fishing club the angler was a member of. The following two questionnaires (one after the interim report in autumn 2009 (T1) and the other one after the final report in winter 2009/2010 (T2)) were short versions of the baseline questionnaire, which only consisted of topics that we intended to change through intervention.

However, all three questionnaires contained items used to elicit the intention to do stocking, the attitude towards stocking, the degree of compensatory thinking, the assumed share of stocked fish in anglers' catches (only T0 and T2), and the rating of the projects` stocking success results (only T1 and T2).

The intention to do stocking was measured by one item and was worded 'How much do you intent to participate in fish stocking in the future?'. The answer scale was a 10 cm long visual-analogue scale (Reips and Funke, 2008), ranging from 0 (not at all) to 100 (absolutely).

The attitude towards stocking was measured at T0 with the following two items: 'My attitude towards fish stocking in rivers with a high degree of naturalness (that means, near natural rivers), is…' and 'My attitude towards fish stocking in rivers with a low degree of naturalness is…' Both items could be answered on a five-point likert scale ranging from 1 = very low to 5 = very high. For T1 and T2 we assessed the attitude more differentiated and formulated five

items altogether. Of these five attitude items, four could be answered on the same five-point likert scale as the attitude items at T0 (1 = very low; 5 = very high). These items were worded 'My attitude towards fish stocking in rivers with a high degree of naturalness and a sufficient natural reproduction is…', 'My attitude towards fish stocking in rivers with a high degree of naturalness and an insufficient natural reproduction is…', 'My attitude towards fish stocking in rivers with a low degree of naturalness and a sufficient natural reproduction is…', and 'My attitude towards fish stocking in rivers with a low degree of naturalness and an insufficient natural reproduction is…'. The fifth item elicited the attitude towards stocking on a very general level ('Overall, I think fish stocking is…') and could be answered using a 10 cm long visual-analogue scale with the verbal anchoring 0 = very bad and 100 = very good.

The degree of compensatory thinking was elicited in every questionnaire with one item only. This item was specially designed to discriminate best between additive and compensatory thinking anglers. It was worded 'Fish stocking should be done independently from the degree of natural reproduction' and could be answered on a five-point scale (1 = I do not at all agree; 5 = I do absolutely agree). Disagreement on this statement was interpreted as a high degree of compensatory thinking, while agreement was seen as a low degree of compensatory thinking.

There was one item in the questionnaire regarding the assumed share of stocked fish in the anglers' catch. It was worded 'What do you think? How many fish of your catch derive from stocking?'. The participants were asked to give a percentage from 0 to 100.

Furthermore, we asked for an overall rating of the stocking success results, where the participants could choose between the answers 'stocking is more successful than I thought', 'the stocking success is in the range that I have expected', 'stocking is less successful than I thought', and 'I do not know'.

VII.2.3.3 Workshop

There were three measurements during the workshop. The first measurement was the participants' rating of the following four statements: 'Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk', 'As little stocking as possible should be done, and if possible, stocking should be completely abandoned', 'Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity', and 'Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the

risk increases to stock above the rivers' carrying capacity and to thus increase competition'. All these statements were presented on flipcharts and the anglers could agree or disagree to them by marking them with red (disagree) or green (agree) points. Because these statements have been presented during the workshop and have been discussed with the anglers, we have no measurements on an individual level but only on a fishing club level. The statements were formulated by us according to represent typical beliefs derived from the compensatory mental model. Figure 4 shows the rating of the statements during the workshops.

Figure 28 [Figure 4 of chapter VII]. Previously formulated statements about stocking were rated by the participants of the workshop. A statement was marked with a green spot in case of agreement and with a red one in case of disagreement. The reasons for agreement and/or disagreement were afterwards discussed.

The second measurement was at the end of the workshop, when the results were discussed with (and among) the participants. We asked the participants which implications the results should have for their future stocking activities and recorded the results on a flipchart. At the end of the discussion, we summarised this flipchart protocol and asked the workshop participants whether we recorded their decisions right or wrong. If something was recorded wrong, we corrected the flipchart statement according to the fishing clubs critique. Thus, we reassured ourselves that the protocols represented the fishing clubs agreements on fisheries management and stocking in the future.

The third and last measurement took place right after the workshop. We asked the participants to respond to a final short questionnaire, which was constructed according to the questionnaires handed out for the interim and final report. Thus, the last short questionnaire (T3) contained items suitable for eliciting the intention to do stocking, the attitude towards stocking, the degree of compensatory thinking, the assumed share of stocked fish in the catch, and a final rating of the stocking success results. These measurements were elicited as described above (VII.2.3.2). All items and statements were originally formulated in German.

VII.3 Results

First, in subsection VII.3.1, the biological results from the success controls are presented. These results are needed because they build the foundation for interpreting the intervention results. For example, if the biological results indicate that stocking was successful, it is very unlikely that the particular fishing club members will change their beliefs about the river and stream ecosystem and stocking: because they received the feedback that stocking is indeed functional in their mainly managed river. So, with our study design, the expected intervention effect depends on the biological results.

Second, regarding the recurring surveys and the workshop, we encountered severe problems with the quality of the elicited data. A total of 248 anglers participated in either the baseline questionnaire (T0), the monitoring surveys (T1, T2), and the workshop (T3) or in a combination of them. Table 1 displays the distribution of participants according to the fishing clubs and the measurement time points. The different fishing clubs are referred to as FC1 to FC6.

Table 9 [Table 1 of chapter VII].
Affiliation of the participants to the fishing clubs (FC1 to FC6) and distribution of participants to the four different measurement time points. Percentages in brackets display the response rates for every single fishing club at every time point.

Fishing club	Baseline T0	Interim Report T1	Final Report T2	Workshop T3
FC1	14 (17.3%)	22 (22.9%)	15 (16.3%)	7
FC2	15 (11.7%)	15 (11.3%)	12 (9.5%)	5
FC3	6 (12.0%)	100 (31.6%)	62 (19.7%)	14
FC4	7 (33.3%)	7 (10.3%)	2 (2.9%)	5
FC5	3 (15.0%)	8 (32.0%)	3 (15%)	4
FC6	8 (44.4%)	7 (38.9%)	9 (50%)	14
Total	53 (16.6%)	159 (24.2%)	103 (16.1%)	50

At the project beginning, we had a problem to receiving the address lists of fishing club members from their presidents. Thus, we distributed the baseline questionnaires among the fishing club members during the trout marking and asked them to also spread it in their fishing club. From a total of 320 baseline questionnaires, only 53 (16.6%) were returned. This very low response rate might be due to the rather long baseline version, which required approximately 1 to 2 hours for filling it in. However, the response rates for T1 and T2 were not much better, even though we managed to get address lists (except from FC4) after the baseline survey and mailed the questionnaires directly to the anglers. The participation in the

workshop was also partially much lower than expected. A further and more severe problem was, that only the minority of participants filled out all four questionnaires, even though they were informed that this would be essential for the research project. Reasons for this very low response rates and willingness to participate are discussed in section VII.4 Discussion.

Overall, when matching the data from the baseline questionnaire and the three following surveys we received more than 85% missings for most items, which made it almost impossible to assess all measurements for an change-over-time analysis. Attempts to impute the missing data using NORM (Schafer, 1997), SPSS 18, or Mplus Version 6 (Muthén and Muthén, 2010) resulted in failure due to a non identifiable or non converging imputation model for the missing values (for details on usage and reliability of multiple imputation see e.g. Lüdtke, Robitzsch, Trautwein, and Köller, 2007; Enders, 2006; van Buuren, 2010; Graham, 2009; Schafer and Graham, 2002; Asparouhov and Muthén, 2010).

Nevertheless, even though we cannot assess the whole measurement from T0 to T3 at once due to too much missing data, we did analyse the data focussing on differences and changes from T0 to T1, and T1 to T2, as well as differences between T2 to T3 regarding the workshop. The intervention results will be presented for each fishing club separately and on an aggregated level in subsection VII.3.2 for these three panels (panel 1: baseline (T0) to interim (T1), panel 2: interim (T1) to final (T2), and panel 3: final report (T2) to workshop (T3)). Thus, with this setup, we are able to access data from anglers who filled out a) the baseline questionnaire and the first short survey (panel 1), b) the first and the second short survey (panel 2), and c) the second short survey and the questionnaire at the end of the workshop (panel 3). The workshop results are reported in subsection VII.3.3. Section VII.3 ends with a summary of the results (VII.3.4).

VII.3.1 Stocking success results

Overall, 11 300 marked trout were stocked in six different rivers at project start in autumn 2008. The fisheries scientists involved in this project analysed the collected data from the stocking success experiments following a standardised Swiss assessment method (Schager and Peter, 2004). The recommendations given based on an evaluation of the stocked trout's share in the overall stock size over time. For this evaluation, the stream-specific environmental conditions were considered. The analyses resulted in the three recommendations a) continue stocking, b) modify stocking, and c) stop stocking. Table 2 summarises the recommendations derived from the stocking success results for each fishing club.

Table 10 [Table 2 of chapter VII].
Recommendations for each fishing club based on the stocking success controls rated by fisheries scientists.

Fishing club	Interpretation	Recommendation
FC1	Good indication for sufficient nat. reproduction.	Stop stocking
FC2	No clear results.	Continue stocking
FC3	Very low nat. reproduction, small stock size.	Continue stocking
FC4	High trout density even though low nat. reproduction. Evidence for spawning sites outside of project area.	Stop stocking
FC5	Spawning site outside of project area, but within project area bad.	Modify stocking: change stocking site
FC6	Strong habitat impairments. Stocked trout and trout from nat. reproduction differ significantly in size.	Modify stocking: change stocking material

Note: The ratings base on the assessment tool 'Modulstufenkonzepte Methode Fische Stufe F' ['Method for assessing running waters; Fishes Level F (covering a large area)'] (Schager and Peter, 2004).

According to the results and ratings in table 2 we concluded, that stocking was not successful or necessary for FC1 and FC4. Thus, the members of these fishing clubs should stop stocking and be most likely to experience stocking as not functional. They should be motivated to change their mental model of stocking and processes in stream and river ecosystems. For FC5 and FC6 the results mean that they should modify their stocking practice. However, stocking cannot be declared as a failure for these fishing clubs. Therefore, the fishing club members are likely to perceive stocking as partly functional. For members of fishing clubs FC2 and FC3 stocking success could not be questioned due to the biological results. This means that there is no reason for members of these fishing clubs to change their view on stocking and fisheries management.

Detailed information on the stocking results for the six participating fishing clubs can be found in the final reports (available on request to the authors).

Overall, strict recommendations can hardly be given. The results of the mark-recapture experiments and the population surveys were complex and various environmental parameters and environmental variability had to be considered for interpreting them. However, for further analysis we refer to FC1 and FC4 as the 'Stop stocking' group, to FC2 and FC3 as the 'Continue stocking' group and to FC5 and FC6 as the 'Modify stocking' group. Table 3 displays how many anglers belong to which group in each of the three analysed panels.

Table 11 [Table 3 of chapter VII].
Distribution of anglers to the biological results based recommendations 'continue stocking', 'modify stocking', and 'stop stocking' for the three assessed panels.

	$N_{panel\ 1}$	$N_{panel\ 2}$	$N_{panel\ 3}$	N_{Total}
Continue stocking	8	53	12	73
Modify stocking	1	6	7	14
Stop stocking	6	12	4	22
Total	15	71	23	109

Thus, we expected for 73 participants (67%) no significant change in their mental model (or to be more precise: in their degree of compensatory thinking). For 22 (20.2%) anglers we expect a strong change in the degree of compensatory thinking and for 14 (12.8%) anglers we hypothesise a medium change according to the biological results. Nevertheless, the number of surveyed anglers is very low especially for the modify stocking condition regarding panel 1 and 2 and the stop stocking condition regarding panel 3.

VII.3.2 Results of recurring surveys for all panels

Regarding the demographics, we did not find significant differences ($p < 0.05$) for the age, level of education, sex, occupation, and fishing experience between the members of the participating fishing clubs. Our sample consisted of male anglers only with a mean age of 56 (min. 14; max. 85) years. Of the participants, 61.7% stated that they had a technical occupation and 17.0% worked as commercial clerks. In the educational field did work 6.4% of the sample and 2.1% had a scientific or artistically work (other occupation: 10.6%). These results corresponded with the highest level of education: the majority of 52.9% said that vocational school was their highest degree, followed by higher professional education (19.6%) and university (11.8%). Obligatory school was mentioned by 9.8% of the sample and 5.9% had another degree as their highest education. The sample consisted of very experienced anglers with a mean fishing experience of 35.14 years (SD 17.4; min. 3; max. 73). According to the non-parametric Kruskal-Wallis test the fishing clubs differed significantly in the main language used and the area of residence: Regarding to differences in the mainly used language, we found that members of FC4 use 'Rätoromanisch' as their main language while all other surveyed clubs stated 'German' as their mainly used language ($\chi^2 = 33.906$; df 5; $p < 0.001$). For the area of residence, we found significant differences between FC2, FC3, and FC6, where the majority lived in periurban areas or small towns, and FC1, FC4 and FC5, where the majority lived in a rural environment ($\chi^2 = 22.735$; df 5; $p < 0.001$).

Regarding the diffusion of relevant project information, we found that in panel 1 83.3% (5) of the stop stocking group, 100% (1) of the modify stocking group, and 50% (4) of the continue stocking group received the interim report. Regarding the final report for panel 2, 58.3% (7)

of the stop stocking group, 83.3% (5) of the modify stocking group, and only 43.3% (23) of the continue stocking group read the final report. For panel 3, we found that 75% (3) anglers of the stop stocking group, 85.7% (6) of the modify stocking group, as well as 91.7% (11) of the continue stocking group received the final report. Overall, most anglers in every panel received the interim report (panel 1) or the final report (panel 2 and 3). Only the diffusion of the final report in panel 2 was especially for the continue stocking group rather low. All anglers in panel 3 have attended the workshop.

VII.3.2.1 Type of mental model and degree of compensatory thinking

Whether an angler is labelled as an additive or compensatory thinking angler is determined by the degree of compensatory thinking (see measurements, section VII.2.3.2). A high degree of compensatory thinking indicates that an angler has a compensatory mental model of stocking, natural reproduction and the stock size of trout, while a low degree of compensatory thinking means that an angler has rather additive beliefs and does not take the degree of natural reproduction into account when thinking about stocking. When looking at the degree of compensatory thinking prior and posterior to the interventions, we find the following results (figure 5).

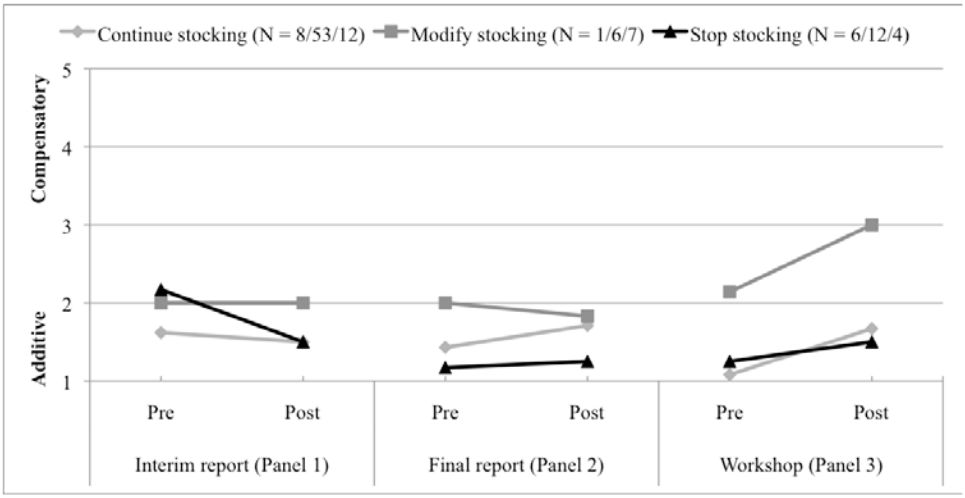

Figure 29 [Figure 5 of chapter VII]. Type of mental models prior and posterior to the interventions per panel. For panel 1, the continue stocking group consisted of 8 anglers, the modify stocking group of 1 angler, and the stop stocking group of 6 anglers. In panel 2 the number of participants was N = 53 (continue stocking), N = 6 (modify stocking), and N = 12 (stop stocking). In panel 3, the number of participants was N = 12 for continue stocking, N = 7 for the modify stocking, and N = 4 for the stop stocking group. 'Pre' refers to the group mean before the intervention, while 'post' refers to the value of the group mean after the intervention.

Overall, the surveyed anglers could be allocated to the additive thinking model, no matter whether it was before or after an intervention. Even though there is a slight change for the "stop stocking" group towards a lower degree of compensatory thinking in panel 1 and a slight increase for all groups in panel 3, we were not able to identify any significant changes by analysing the data with a paired sample t-Test ($p < 0.05$) for each panel. Furthermore, we did not find any significant differences within the panels between the prior or the posterior type of mental model according to the non-parametric Kruskal-Wallis H-Test ($p < 0.05$).

The change in the type of mental model was our main dependent variable. It was assessed by building the differences between the degree of compensatory thinking prior and posterior to each intervention for every panel and group. This means, that a positive difference indicates a decline in the degree of compensatory thinking, while a negative difference indicates an increase. A difference of zero stands for the same degree of compensatory thinking at both compared time points. Figure 6 displays the differences found in the degree of compensatory thinking for all three panels and groups.

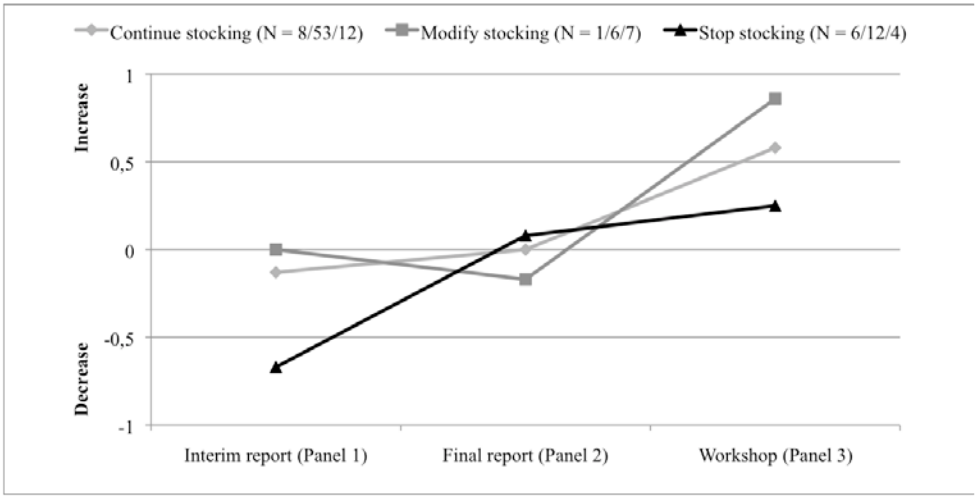

Figure 30 [Figure 6 of chapter VII]. Changes in the degree of compensatory thinking for anglers who can continue stocking, should modify stocking, and should stop stocking according to the biological results after the interim report (panel 1; Continue stocking: N = 8, Modify stocking: N = 1, Stop stocking: N = 6), the final report (panel 2; Continue stocking: N = 53, Modify stocking: N = 6, Stop stocking: N = 12), and after attending to the workshop (panel 3; Continue stocking: N = 12, Modify stocking: N = 7, Stop stocking: N = 4)

As figure 6 indicates, there is no change for anglers belonging to the continue- or modify stocking group in their degree of compensatory thinking after the interim report or the final

report. For the stop stocking group, figure 6 indicates a slight decrease in the degree of compensatory thinking after the interim report. Regarding the change in the degree of compensatory thinking, figure 6 displays a slight increase for all groups after attending to the workshop. However, according to One-Sample t-tests, the changes in the degree of compensatory thinking did not differ significantly from zero ($p < 0.05$). Thus, neither the interim report, the final report nor the workshop had a significant impact on changing the degree of compensatory thinking for anglers belonging to any of the three groups.

VII.3.2.2 Attitude towards stocking

As described in section VII.2.3.2 we assessed the attitude towards stocking on a global level and differentiated for the degree of naturalness as well as for natural reproduction. Unfortunately, these measurements were not included in the baseline questionnaire. Therefore, we analysed the results only for panel 2 and panel 3. Figure 7 displays the change of attitude towards stocking in general for panel 2 and panel 3.

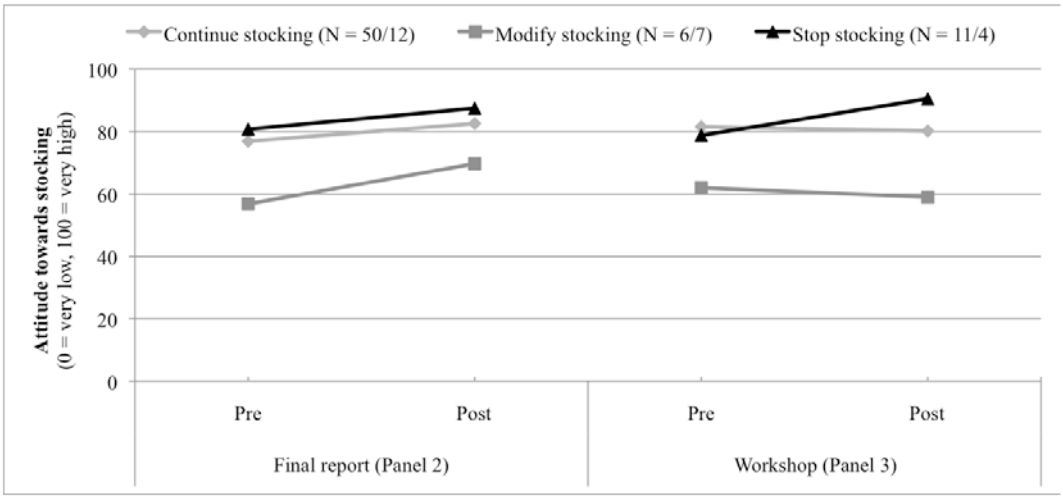

Figure 31 [Figure 7 of chapter VII]. Changes in the general attitude towards stocking after the final report (panel 2; Continue stocking: N = 50, Modify stocking: N = 6, Stop stocking: N = 11) and after the workshop (panel 3; Continue stocking: N = 12, Modify stocking: N = 7, Stop stocking: N = 4). 'Pre' refers to the group mean before the intervention, 'Post' to the group mean after intervention.

According to figure 7, all participants had a very high general attitude towards stocking, regardless of prior or posterior measurements in both analysed panels. A paired sample t-Test resulted in no significant differences ($p < 0.05$) between the prior or posterior attitude towards stocking. However, in contrast to our expectations, figure 7 indicates that there is a tendency

for an increase in the general attitude for all groups in panel 2 and for the "stop stocking" group in panel 3. On the other hand, the general attitude towards stocking does not seem to be affected by the workshops for the continue stocking and the modify stocking group. Within the panels between the groups, there was a significant difference for the posterior attitude towards stocking between the stop stocking and the modify stocking group. The stop stocking group had a significantly higher attitude towards stocking compared to the modify stocking group (U-Test, Z = -2.079 p = 0.038).

Regarding the stocking attitude measurements where we differentiated between the degree of naturalness and the degree of natural reproduction, we found results comparable to the general attitude towards stocking. Table 4 summarises these findings.

Table 12 [Table 4 of chapter VII].
Changes in the attitude towards stocking differentiated by the degree of naturalness and the degree of natural reproduction. Table shows results of paired sample t-Test for both analysed panels.

River characteristics					Attitude (mean)				
Degree of naturalness	Degree of nat. reproduction	Group	Panel	N	prior	posterior	Difference	t-value	p
High	High	continue stocking	2	50	3.26	3.22	0.040	0.270	0.789
			3	12	3.08	3.08	0.000	0.000	1.000
		modify stocking	2	6	2.17	2.17	0.000	0.000	1.000
			3	7	2.00	1.43	0.571	1.922	0.103
		stop stocking	2	12	3.33	3.08	0.250	0.609	0.555
			3	4	3.25	2.75	0.500	0.378	0.731
High	Low	continue stocking	2	50	4.26	4.50	-0.240	-2.471	0.017*
			3	12	4.50	4.42	0.083	0.364	0.723
		modify stocking	2	6	4.17	4.17	0.000	0.000	1.000
			3	7	3.86	4.14	-0.286	-1.549	0.172
		stop stocking	2	12	3.83	4.00	-0.167	-0.456	0.658
			3	4	4.25	4.25	0.000	0.000	1.000
Low	High	continue stocking	2	46	3.15	3.26	-0.109	-0.658	0.514
			3	11	3.09	3.73	-0.636	-1.472	0.172
		modify stocking	2	6	2.33	2.00	0.333	0.598	0.576
			3	7	2.43	1.86	0.571	1.922	0.103
		stop stocking	2	10	2.90	3.00	-0.100	-0.361	0.726
			3	4	3.00	3.25	-0.250	-0.151	0.889
Low	Low	continue stocking	2	46	4.20	4.26	-0.065	-0.621	0.538
			3	11	3.64	4.36	-0.727	-1.789	0.104
		modify stocking	2	6	4.00	3.67	0.333	0.598	0.576
			3	7	4.00	3.86	0.143	0.420	0.689
		stop stocking	2	11	3.36	3.91	-0.545	-1.200	0.258
			3	4	3.25	4.25	-1.000	†	†

Note: The differentiated attitude was not elicited for panel 1. * = significant at $p < 0.05$ † = cannot be computed because SD = 0

Referring to table 4, we found only one significant difference after the final report for the group that could continue stocking regarding the attitude towards stocking in rivers with a high degree of naturalness and a low degree of natural reproduction ($p < 0.05$). This group increased their attitude from an average of 4.26 to 4.5. The majority of the anglers did not change their attitude, neither in panel 2 after the final report nor in panel 3 after the workshop.

Regarding the posterior difference within panel 3, we found that the group that should modify stocking had a significantly lower attitude towards stocking in rivers with a high degree of naturalness and high degree of natural reproduction compared to the group that could continue stocking (U-Test, $Z = -3.170$, $p = 0.002$). The same result was found for the attitude towards stocking in rivers with a low degree of naturalness and a high degree of natural reproduction: Again, the group that should modify stocking according to the biological results had a significantly lower attitude compared to the group that could continue stocking (U-Test, $Z = -2.958$, $p = 0.003$). In panel 2, for the prior attitude towards stocking in rivers with low degree of naturalness and low degree of natural reproduction, we found a significant difference between the group that should continue stocking and the group that should stop stocking: the latter group scored significantly lower on that particular attitude item (U-Test, $Z = -2.673$, $p = 0.008$). However, this significant difference disappeared for the posterior attitude in panel 2 between these two groups.

VII.3.2.3 Intention to do stocking

When looking at the intention to do stocking, we found that most changes were not significant according to a paired sample t-Test ($p < 0.05$). Only the group that should stop stocking changed their intention to do stocking significantly after receiving the interim report ($t = 3.003$, $p = 0.040$). The results for all groups and all panels are displayed in figure 8.

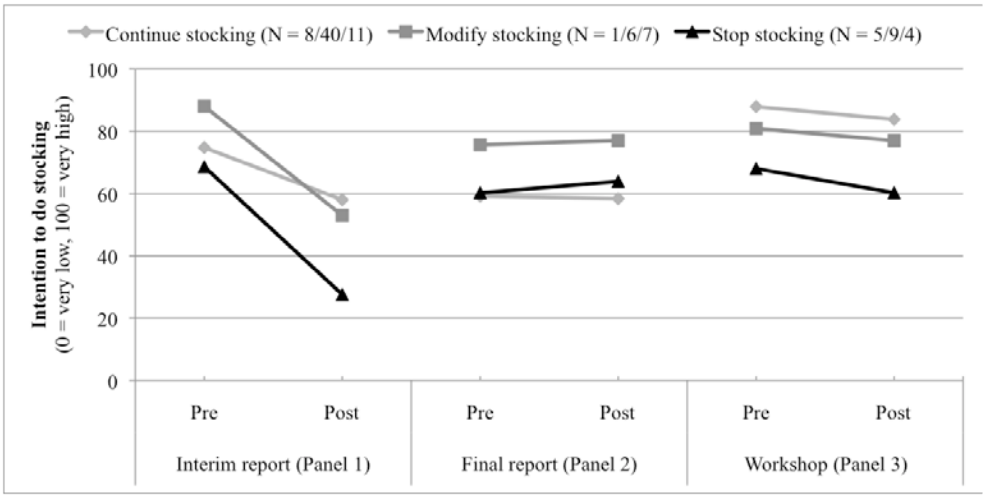

Figure 32 [Figure 8 of chapter VII]. Changes in the intention to do stocking split by biological implications of stocking results and for the three different panels (panel 1: Continue stocking: N = 8, Modify stocking: N = 1, Stop stocking: N = 5; panel 2: Continue stocking: N = 40, Modify stocking: N = 6, Stop stocking: N = 9; panel 3: Continue stocking: N = 11, Modify stocking: N = 7, Stop stocking: N = 4). 'Pre' refers to the group mean before the intervention, 'Post' to the group mean after intervention.

Interestingly, the intention decreased strongest after the interim report for all groups. The overall intention to do stocking is rather high for all groups and all panels. Only the "stop stocking" group tends to have a lower intention regarding stocking (panel 1 and 3) compared to the other groups. However, a Kruskal-Wallis H-Test did not indicate any significant differences within each panel when comparing the prior or posterior intention to do stocking between the three groups ($p < 0.05$).

VII.3.2.4 Share of stocked fish in angler catch

A very important measurement regarding the anglers' perception of stocking success was the perceived or assumed share of stocked fish in the anglers' catch, which is likely to be overestimated (Burkhardt-Holm et al., 2005). Figure 9 shows how anglers belonging to the three groups rated the amount of stocked fish in their catches after the interim report, the final report and after the workshop.

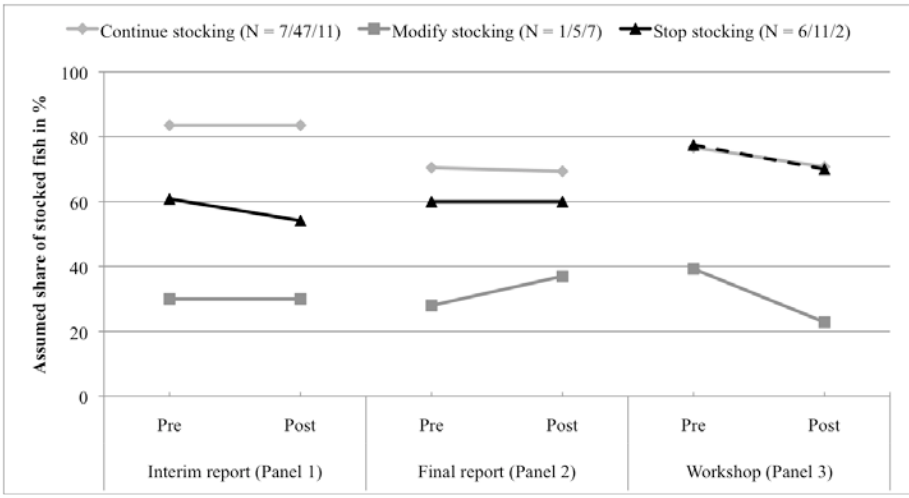

Figure 33 [Figure 9 of chapter VII]. Change in the assumed share of stocked fish in the anglers' catch for every panel and group. (panel 1: Continue stocking: N = 7, Modify stocking: N = 1, Stop stocking: N = 6; panel 2: Continue stocking: N = 47 Modify stocking: N = 5, Stop stocking: N = 11; panel 3: Continue stocking: N = 11, Modify stocking: N = 7, Stop stocking: N = 2). 'Pre' refers to the group mean before the intervention, 'Post' to the group mean after intervention.

The results of a paired sample t-Test did not indicate any significant changes in the anglers' assumed share of stocked fish in their catches for any panel ($p < 0.05$). Nevertheless, figure 9 denotes a decreasing tendency in the believed share for all three groups in panel 3. Additionally, the percentages for the modify stocking group are remarkably low in panel 1, 2 and 3. A performed Kruskal-Wallis H-Test revealed that the percentages differed significantly within the panels between the groups, except the posterior percentage in panel 1 and 2 (all $p < 0.05$). The U-Test was used to analyse between which groups the differences were located. The results are given in table 5.

Table 13 [Table 5 of chapter VII].
The significant differences within the three panels between the groups were located using the U-Test.

Panel	Between groups…		Z	p
before interim report	continue stocking	stop stocking	-2.096	0.036**
before final report	continue stocking	modify stocking	-2.511	0.012**
	modify stocking	stop stocking	-1.864	0.062*
after final report	continue stocking	modify stocking	-1.817	0.069*
before workshop	continue stocking	modify stocking	-2.433	0.015**
after workshop	continue stocking	modify stocking	-2.916	0.004**
	modify stocking	stop stocking	-1.857	0.063*

Note: * = significant at $p < 0.1$ ** = significant at $p < 0.05$

Thus, we can conclude that the stop stocking group at panel 1 had assumed a significantly lower share of stocked fish in their catch compared to the continue stocking group before the interim report. Additionally, the modify stocking group in panel 2 had assumed a significantly lower share of stocked fish in their catch compared to the continue stocking (prior and posterior to the final report) and to the stop stocking group (only prior to final report). Before the workshop, the modify stocking group assumed a significantly lower share of stocked fish in their catch than the continue stocking group did, while after the workshop also the difference to the stop stocking group became significant.

Figure 9 also indicated that the stop stocking group seems to increases their believed share of stocked fish in the catch when comparing panel 1 to panel 2 and 3. However, a statistical comparison across the panels will not lead to valid and reliable results, because panel 1, 2 and 3 consisted of mostly different anglers from the same group (this would mix-up dependent and independent measurements). Therefore, this apparent development for the stop stocking group had to remain un-analysed but will be discussed in section VII.4.

VII.3.2.5 Rating of stocking success and implications

When asked for an overall rating of stocking in the framework of this research project, we assumed that the anglers who belong to the stop or modify stocking group would rate stocking as being less successful than they have thought. Figure 10 summarises the change in the overall rating of the stocking success for the three panels and the three groups.

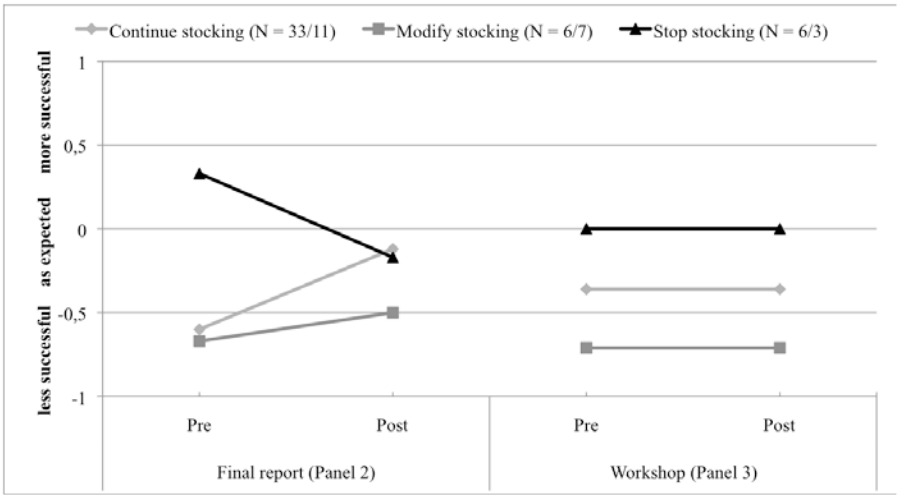

Figure 34 [Figure 10 of chapter VII]. Change in the rating of the overall stocking success for panel 2 and 3. Panel 1 could not be analysed because there was no overall rating of stocking success in the baseline questionnaire (panel 2: Continue stocking: N = 33, Modify stocking: N = 6, Stop stocking: N = 6; panel 3: Continue stocking: N = 11, Modify stocking: N = 7, Stop stocking: N = 3). 'Pre' refers to the group mean before the intervention, 'Post' to the group mean after intervention.

As can be inferred from figure 10, the stop stocking group tended to change their rating of stocking success from more successful than expected to less successful than expected in panel 2, while the other two groups tended to rate stocking better after the final report. For panel 3 we could not discover a change in the overall rating of the stocking success. The continue stocking and modify stocking group rated stocking as less successful before attending the workshop and maintained their rating throughout the workshop, whereas the stop stocking group kept rating the stocking success as 'as expected'. According to a paired sample t-Test, the rating of stocking success did not change significantly ($p < 0.05$) in any panel. Within the panels and between the groups were no significances discovered (Kruskal-Wallis H-Test, $p < 0.05$). Overall, most participants tended to rate the overall stocking success as lower than they had expected.

VII.3.2.6 Impact of the type of mental model on attitude toward stocking and intention to do stocking

We assessed, whether the attitude toward stocking or the intention to do stocking depended on the type of mental model, with linear regression analyses. In the first

regression analysis, we declared the global attitude towards stocking (after intervention) as the main dependent variable. The independent variable was the change in the degree of compensatory thinking and the degree of compensatory thinking (after the intervention). Additionally, we controlled for time (after interim report, final report or workshop), biological implication of stocking results and the global attitude towards stocking prior to the intervention. The results of this regression analysis are displayed in table 6.

Table 14 [Table 6 of chapter VII].
Results for the global attitude toward stocking after intervention (dependent variable) regressed on the independent variables 'degree of compensatory thinking after intervention' and 'change in the degree of compensatory thinking'. Additionally, the regression was controlled for 'time', 'biological implications of stocking results' and 'global attitude prior to intervention' (N = 90).

Variables included	Unstandardized coefficients B	Std. Error	Beta	t	p
(Constant)	35.325	13.580	-	2.601	0.011*
Time	-5.333	3.735	-0.136	-1.428	0.157
Biological implications	1.142	2.005	0.051	0.569	0.571
Change in degree of compensatory thinking	6.648	2.328	0.347	2.855	0.005**
Degree of compensatory thinking (after intervention)	8.503	2.151	0.487	3.953	0.000**
Global attitude (prior intervention)	0.221	0.069	0.303	3.206	0.002**

Note: * = $p < 0.05$, ** = $p < 0.01$, adj. $R^2 = 0.302$, $F = 8.686$, $p < 0.001$

The regression explained 30.2% of variance for the global attitude toward stocking posterior to intervention (adjusted $R^2 = 0.302$) and was highly significant ($F = 8.686$, $p < 0.001$). The degree of compensatory thinking and the change in the degree of compensatory thinking were the two most influential predictors for the global attitude toward stocking prior to intervention. Thus, we concluded that a change in the degree of compensatory thinking and the degree of compensatory thinking in itself toward the compensatory mental model decreases the attitude towards stocking, while a change in favour of the additive mental model increases the attitude towards stocking.

We conducted a similar regression analysis for the intention to do stocking. The results can be seen in table 7.

Table 15 [Table 7 of chapter VII].
Results for the intention to do stocking after intervention (dependent variable) regressed on 'degree of compensatory thinking after intervention' and 'change in the degree of compensatory thinking'. Additionally, the regression was controlled for 'time', 'biological implications of stocking results' and 'intention to do stocking prior to intervention' (N = 91).

Variables included	Unstandardized coefficients B	Std. Error	Beta	t	p
(Constant)	-19.017	18.553	-	-1.025	0.308
Time	10.706	4.265	0.199	2.510	0.014*
Biological implications	-2.847	3.142	-0.068	-0.906	0.367
Change in degree of compensatory thinking	3.190	3.213	0.095	0.993	0.324
Degree of compensatory thinking (after intervention)	4.263	3.233	0.122	1.319	0.191
Intention (prior intervention)	0.661	0.076	0.653	8.663	0.000**

Note: * = $p < 0.05$, ** = $p < 0.01$, adj. $R^2 = 0.499$, $F = 18.942$, $p < 0.001$

The intention to do stocking prior intervention was the most powerful significant predictor for the intention posterior to intervention ($p < 0.001$). Additionally, the time (after interim report, final report or workshop) had a significant effect on the intention to do stocking, which means that the intention raises the more time has passed. With this regression analysis, 49.9% of variance for the intention to do stocking could be explained (adjusted $R^2 = 0.449$, $F = 18.942$, $p < 0.001$).
Overall, we can conclude that the degree of compensatory thinking and the change in the degree of compensatory thinking significantly impacts the global attitude towards stocking, but did not impact the intention to do stocking directly.

VII.3.3 Commitments at the workshop and agreement on fisheries management objectives with the fishing clubs

This section focuses on the results acquired at the workshops. Because the agreements on fisheries management objectives and commitments made by the participants regarding stocking were depended on local circumstances for every fishing club, we process the results for every fishing club, grouped by the biological implications of the stocking results.

Besides eliciting the impact of stocking success controls and stocking success feedback via recurring surveys, we assessed the participating anglers reactions on a more qualitative level in the workshops. First, we presented to the participants four statements (see section VII.2.3.3 Measurements) on stocking and fisheries management and

confronted them with the rating of these statements by compensatory thinking anglers from a previous Swiss-wide survey study. After explaining these results to the participants, we asked them to rate whether they agree or disagree to each statement. In the following, the results for FC1 to FC6 in order of the biological recommendations are reported.

VII.3.3.1 Biological recommendation: FC2 and FC3 could continue stocking

For FC2, the workshop was scheduled on the 30th of March 2010. A total of seven persons participated in the workshop. Among the participants were one guest and one official delegate of the respective cantonal fisheries administration. The other five participants were members of FC2.

When discussing the above-mentioned four statements (see section VII.2.3.3 measurements) with the participants, we received the following rating from the fishing club members (table 8).

Table 16 [Table 8 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC2 during the workshop (N =5).

Statement	Agree	Disagree	Total
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	4	1	5
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	0	5	5
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	5	0	5
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	3	2	5

When discussing the rating of the statements, the club members confirmed that it would be feasible to stop stocking if there was a sufficient natural reproduction. But because many rivers in the area they live in are impacted by hydropower plants, the anglers doubted that natural reproduction in their region would be sufficient and trout stocks could thrive without stocking. But nevertheless, they stated that a long-term ideal goal would be to have a trout stock that goes exclusively back to natural reproduction. In general, the fishing club members agreed that stocking success in general is very hard to

assess and they were of the opinion that stocking has always to be inferred from more or less precise assumptions. Regarding the degree of compensatory thinking, three anglers agreed that natural reproduction should be considered when planning stocking, while two rejected this statement. However, some participants mentioned that stocking could not be planned depending on the natural reproduction, because there were too many hydropower-plants and river training structure (obstacles, barriers, etc.) in their mainly used river. When comparing these results to the degree of compensatory thinking given in the post-workshop survey, all members of FC2 clearly rejected the compensatory thinking that stocking should be done depending on the degree of natural reproduction.
The biological results for FC2 were complex. According to the habitat and trout stock assessment it could be inferred that FC2 could continue stocking. The fishing club members decided to follow up on the ongoing stocking success controls by counting all marked fish in their future catches. Even more, they mentioned that they will stop stocking in a small stream and monitor, how the trout population develops without stocking. Additionally, they thought of promoting habitat improvements to foster natural reproduction, but also mentioned that they expect resistance from the hydropower-plant lobby. Generally, they decided to continue with stocking.

The second fishing club that could continue stocking was FC3. A total of 16 members (and two representatives of the cantonal administration) attended the workshop, which was held on 1st of April 2010. During the workshop, we asked the participants to rate the four statements on fisheries management and stocking. The results are summarised in table 9.

Table 17 [Table 9 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC3 during the workshop (N = 16).

Statement	Agree	Disagree	Total*
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	5	10	15
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	9	5	14
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	15	1	16
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	8	8	16

* *Note:* One angler did not rate statement 1, two refused to rate statement 2.

Regarding the rating of the statements, the members of FC3 stated during the workshop that they were convinced that the trout they used for stocking were healthy and well-suited for their mainly used river. Several participants questioned the biological assessment of the degree of natural reproduction and doubted the validity of the results. Instead, they insisted that natural reproduction could not be assessed easily and that therefore all biological results are more or less vague. While 50% of the participants could be allocated to the additive mental model according to their degree of compensatory thinking during the workshop, only 14.3% of the members of FC3 agreed to the compensatory beliefs in the post-workshop survey (another 14.3% were undecided and 71.4% stated that stocking should be done independently of natural reproduction).

The biological results indicated a very low natural reproduction for the mainly used river of FC3. Congruent with this result, the agreement on future fisheries management and stocking by FC3 was that they would continue with stocking. However, a few questions were raised by fishing club members regarding the low natural reproduction. In particular, the fishing club members wondered why the natural reproduction was so low and thought of the food availability in the river. They discussed trying to improve the habitat by planning to increase the water body connectedness. Additionally, they discussed the possibility of monitoring the natural reproduction and the size of trout stocks in the future.

VII.3.3.2 Biological recommendation: FC5 and FC6 should modify stocking

For FC5, the workshop was scheduled on the 9th of April 2010 and 6 fishing club members attended it. When analysing the rating of the four statements, we got very consensus results for FC5 (table 10).

Table 18 [Table 10 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC5 during the workshop (N = 6).

Statement	Agree	Disagree	Total*
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	0	6	6
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	4	1	5
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	5	0	5
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	6	0	6

* *Note:* One angler did not rate statements 2 and 3.

Referring to risks associated with stocking, which have been explained to the fishing club members right before the rating of the statements, we were surprised that all anglers of FC5 rejected the statement. As a reason for denying risks associated with stocking, the members explained that they always used fish derived from local parents caught in the wild, locally reared under natural conditions and only healthy trout for stocking. Therefore, they concluded that stocking was no risk for their river, but agreed that stocking might be a risk for river and stream ecosystems if fish health was not considered when buying or rearing trout. Regarding the degree of compensatory thinking and the acceptance of a carrying capacity of rivers for the maximum of trout that can be supported, we found a similar picture as for FC1 (see below). The workshop participants seemed to agree to the compensatory beliefs and rejected the additive ones. But again, the picture changed when looking at the results of the post-workshop survey: only one angler of FC5 could be allocated to the compensatory model, another one was undecided and four anglers stated that stocking should be done independently from natural reproduction. Again, the results for the degree of compensatory thinking during the workshop and right after the workshop seemed to contradict each other, similar to the observations made at FC1.

As agreements on future management decisions and stocking, the members of FC5 decided that they will adjust stocking sites and only stock in a lower part of the river where the stocking success results revealed that the degree of natural reproduction was low. They agreed that stocking was unnecessary at some of their previously used stocking sites. Thus, they planned to change their stocking sites and intended to follow

up with stocking success controls by recording whether a trout was marked or not in their catch diaries. On the other hand, they made clear that they would never abandon stocking, regardless of its success. As main reasons for this statement they mentioned that stocking was not only a fisheries management tool to increase stock sizes, but that it had also psychological effects. First, according to their explanations, they utilised stocking as demonstrating to the public that they 'take care for their river and its trout', and second, they celebrated stocking as a social event that promotes a feeling of belonging together among the fishing club members. Overall, the decisions made by the fishing club were congruent with the recommendations derived from the biological results.

The workshop for FC6 was conducted on the 15th of March 2010 and 14 members of the club (plus two guests and one representative from the cantonal administration) attended it. Regarding the rating of the statements, the majority of the participants agreed to statement 1, 3, and 4, whereas one half of the participants (6) agreed to statement 2 and the other half (7) disagreed to it (see table 11).

Table 19 [Table 11 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC6 during the workshop (N = 13).

Statement	Agree	Disagree	Total
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	12	1	13
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	6	7	13
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	13	0	13
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	13	0	13

During the discussion of these statements, some anglers of FC6 mentioned that no stocking should be conducted if there was sufficient natural reproduction. On the other hand, some other anglers where of a different opinion and stated that they would not abandon stocking completely. All participants agreed that the habitat structure in their stream was poor. On the other hand, the anglers were sure that the water quality had remarkably improved over the last years. Comparing the rating of the degree of compensatory thinking during the workshop with the degree of compensatory thinking

resulted from the post-workshop survey, we found that 28.6% (4) anglers of FC6 could be allocated to the compensatory model, 42.8% (6) belonged to the additive model, and another 28.6% (4) were undecided. Thus, the degree of compensatory thinking was highest for FC6 during and after the workshop, compared to the other fishing clubs.

The biological results indicated that the members of FC6 should modify stocking. When looking at the agreements on future management and stocking by the members of FC6, we can conclude that they drew the right conclusions from the stocking success controls. They decided to not longer buy hatchery-reared trout for stocking, but to raise them in a brook themselves (within the same catchment as their mainly used river) instead. Additionally, they agreed on improving their stocking procedure and on promoting habitat improvements to foster natural reproduction. Furthermore, they planned to follow up on stocking success controls by recording marked trout in their catch diaries.

VII.3.3.3 Biological recommendation: FC1 and FC4 should stop stocking

The workshop for FC1 was conducted on the 16th of April 2010. There were a total of 11 participants, of whom one was a guest and the rest members of FC1. Additionally, one representative of the cantonal administration attended the workshop. Table 12 summarises the rating of the statements for the participants.

Table 20 [Table 12 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC1 during the workshop (N = 11).

Statement	Agree	Disagree	Total*
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	4	6	10
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	0	11	11
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	10	0	10
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	8	3	11

* *Note:* One angler did not rate statement 1 and 3.

As can be seen in table 12, all participating members of FC1 agreed that every river had a limited carrying capacity regarding the amount of trout that can dwell in it. But on the other hand, they denied that stocking numbers should be lowered if possible. Interestingly, for the rating of the fourth statement, that stocking should be done depending on the degree of natural reproduction, we see that 8 of 11 anglers agreed, which means that they accepted the compensatory belief right after discussing them. When comparing this result to the answers given by the members of FC1 in the survey right after the workshop, we got a different picture: 6 anglers stated in the survey that stocking should be done independently from natural reproduction and only one angler chose "partly agree – partly disagree" as an answer. Of the participants from FC1, 4 anglers did not fill out the survey after the workshop. Thus, the rating of the statement in the workshop and the rating of the same statement in the survey lead to contradicting results for members of FC1.

The biological results indicated for FC1 that stocking could be stopped, as natural reproduction seems sufficient. Regarding the agreements on future fisheries management and stocking, the members of FC1 stated that natural reproduction seemed to be sufficient in their mainly used river, that the habitat was in a good condition and that there was enough food available for trout stocks. The only negative aspect mentioned was that the water discharge constantly decreased over the last past years. Thus, not only the biological results implied that stocking should be abandoned, but also the statements given by the fishing club members suggested that they were likely to stop stocking. However, as a final statement the participating members of FC1 inferred from their own ratings and from the biological results, that they should continue stocking the way they always did it. They concluded that '20 years of stocking experience cannot be wrong, regardless what results from stocking success controls derive'. Even a summary of their own rating of the habitat and of the natural reproduction could not initiate a change in the conclusions made by the members of FC1.

The second fishing club that should stop stocking according to the biological results was FC4. Of this fishing club, five members and one delegate from the canton attended the workshop on the 26th March 2010.
The four statements were rated by the anglers of FC4 as summarised in table 13.

Table 21 [Table 12 of chapter VII].
Rating of four statements regarding pro-environmental fisheries management by members of FC4 during the workshop (N = 4).

Statement	Agree	Disagree	Total
Stocking cannot only contribute to spreading of diseases, it has also the potential to increase competition within trout stocks and might lead to hybridisation between wild and stocked trout. Therefore, stocking is always a risk.	0	4	4
As little stocking as possible should be done, and if possible, stocking should be completely abandoned.	3	1	4
Each stream and river can only sustain a limited number of trout. Therefore, the number of stocked fish has always to be adapted to the rivers' specific carrying capacity.	0	4	4
Stocking should always be planned and done depending on the degree of natural reproduction. If natural reproduction is successful, better stop stocking. Otherwise, the risk increases to stock above the rivers' carrying capacity and to thus increase competition.	2	2	4

When we asked the participants why they rejected statement 1 and 3, they explained that they only used local trout for stocking and that there were no known diseases in their mainly used running waters. Therefore, stocking was not associated with any risk for them. In the upcoming discussion of statement 3, we pointed out why the condition of the habitat was the limiting factor for the amount of trout that can dwell in a river. As a result, the participants admitted that this was true and that they had misunderstood the statement before. Compared to the ratio of 50:50 for agreement on the main belief of the compensatory mental model, we found a ratio of 25:75 in favour of disagreement to that particular belief in the post-workshop survey (N = 4).

According to the biological results, it could be recommended for FC4 that stocking should be stopped due to an overall high trout population density, even though there was only little natural reproduction in the stretches surveyed. When this surprisingly high density was discussed and it was supposed by us that there have to be excellent spawning sites outside the project area, a few anglers mentioned, 'it might be that someone stocked the river illegally with additional unmarked trout'. The delegate from the canton made clear that according to the cantons' and his knowledge no trout were stocked outside the project area. The anglers replied that there 'happens a lot without knowledge of the officials' in the region where they lived. However, the fishing club president ended the discussion by stating that the additionally conducted stocking is just an assumption and possibility.

As agreements on future stocking the fishing club decided that they continue to do stocking. They agreed to report how many marked trout they catch in the following fishing seasons. Even though indicated by the biological results, abandon stocking was not discussed as an option.

VII.3.4 Summary of results

Overall, the results do not support the assumptions of most of our hypotheses (section VII.1). In particular, regarding hypothesis 1, we did not discover any significant change in the type of mental model or the degree of compensatory thinking after the interim report, the final report or the workshop, regardless, of implications of the biological results. Referring to our second hypothesis, that stocking success controls will lower the anglers' assumed share of stocked fish in their catches, we failed again to reveal any significant changes during our project. The same result applies to our assumption, that the workshop (designed as our main intervention) impacts the mental model, attitude toward stocking, and intention to do stocking stronger than the interim or final report does. Referring to our data, we cannot assume that there were any significant changes according to any of the interventions. However, we found evidence for our third hypothesis: the degree of compensatory thinking and changes in the degree of compensatory thinking significantly affect the global attitude towards stocking, but not directly the intention. This is congruent with findings of previous research (von Lindern and Mosler, submitted, chapter VI).

Nevertheless, even though we could not discover significant changes, we could observe tendencies of change for all analysed constructs. The degree of compensatory thinking tended to rise after the workshop was conducted. The anglers' assumed share of stocked fish in their catches seemed to decline during the project. The strongest tendencies for change in the intended direction could be observed for the group that should modify stocking, followed by the continue stocking group. In contrast to our assumption that the stop stocking group should change strongest due to an increased motivational and informational basis derived from the stocking success results, it pointed out that this group seemed to be the most unlikely group to change. This observation will be subject to discussion in section VII.4.

Summarising the results of the workshop, we could conclude that they were overall a success. Both fishing clubs that could continue with stocking (FC2 and FC3) decided to do so, but additionally wanted to follow up on stocking success controls by recording

the amount of marked trout in their catch diaries. They wanted to promote habitat improvements to foster natural reproduction of trout. FC2 even wanted to stop stocking in a small neighbouring stream to assess the degree of natural reproduction over time. The fishing clubs that should modify their management and stocking practice (FC5 and FC6) also decided in favour of change. FC6 planned to rear their own trout for stocking instead of buying trout, which can be considered as more appropriate stocking strategy. FC5 decided to change the stocking site so that in the future trout are stocked where there is a lack of natural reproduction, which can also be considered as a positive outcome. Only the two fishing clubs that should stop stocking (FC1 and FC4) did not decide to do what would be appropriate according to the biological results. Instead, the members of both clubs argued to continue with stocking because '20 years of experience cannot be wrong' (FC1), regardless results of stocking success controls. For FC4, the project could partly be considered as success, because the members decided to think about changing their stocking site. But on the other hand, we had clues that members of FC4 undermined the stocking success controls by illegally conducting additional stocking right outside of the project area.

VII.4 Discussion

When looking at the results, it is obvious that we could not analyse this study as it was designed to be analysed: as a longitudinal study with a baseline measurement and three follow-up measurements, one after every intervention. The reasons for this lay in the poor quality of data in our measurements, mostly resulting from a very low compliance of the participating anglers (see section VII.3 Results). We are still not sure why the response rates and the participation rates were so low. The reasons might be manifold. First, we noticed that the presidents of the fishing clubs initially tried to refuse to give us a list of their members. Thus, we could not mail the first questionnaires directly to the anglers but had to distribute them during the fieldwork (panel 1). Even though the fishing club presidents agreed to spread the questionnaires in their fishing clubs, we learned that most of them did not do so, but handed the surveys only over to members who they assumed to participate in the study. Second, especially the baseline questionnaire was very long and demanding due to many open-ended questions, what surely lowered the response rate. Third, not only the response rate regarding the surveys was dramatically low, but also the interest in the workshop and the stocking results was far below our expectations. This might lead to the assumption, that the vast majority of anglers were just not interested in the stocking success or the project. This assumption gets support from remarks of some fishing club presidents, who told us that even they were not able to reach every member of their club (also for other club matters).

Another interesting finding was that in contrast to our assumptions, the stop stocking group was affected less by the interventions and the stocking results compared to the other groups. On a second thought, this finding sounds reasonable: Breakwell (2001) pointed out, that mental models are connected to values and described the significance of mental models for the identity process. Following Breakwells thought, we can assume that stocking is far more than just a management tool for the majority of anglers (at least in Switzerland). The remarks done by members of FC5 support this assumption: they stated that they would never stop stocking because it was important for their feeling of belonging together. The statements by members of FC1, that stocking experience from 20 years cannot be wrong, could be interpreted in the same direction. FC1 puts lots of effort over years into stocking by sampling the trout for stocking from a number of small rearing brooks and thus, it might be too confronting to recommend stop stocking to them. Additionally, we know from other fishing clubs that they often maintain hatcheries and spend a lot of time and money on rearing trout for

stocking. Thus, we might have initiated the building of a polemical mental model (Breakwell, 2001; Moscovici, 1988), which focuses not on the facts but on the defence of the own position and own values. Following this argumentation, it is not surprising that the modify stocking group tended to be affected strongest by our interventions. We did not question their behaviour, but initiated discussion about how to improve the outcome of stocking.

Regarding the workshops, we found that most participants agreed to the compensatory beliefs during the workshop, but disagreed to the same statement in the post-workshop survey, which was handed out and filled in just after the workshop. A reason for this contradicting result might be, that the anglers understood during the workshop that the compensatory beliefs were favourable from our point of view and rated this statement according to our expectation. Thus, the rating during the workshop may have resulted from too many cues given by us, what we expect the participants to state. Unfortunately, we did not assess in how far the participants tended to give answers that where socially desirable. Another explanation might be, that if anglers are on their own when interpreting complex biological results, they will not change their mental models, especially if the results can be attributed to other circumstances than low functionality of stocking. On the other hand, when the results are presented and discussed with them in interactive workshops, where relations between different aspects can be explained to them, they are more likely to change. Thus, a conclusion would be, that guidance is needed to channel the uncertainty derived from not-expected results in a change of particular belief structures. It seems, that reports and participation is not enough to ensure a change in beliefs in the intended direction, while a workshop gives the opportunity to give guidance for interpretation, thus promoting a change in the intended direction towards a more adequate fisheries management.

Last but not least, the very high global attitude toward stocking for all participants might be considered as a factor that made it extremely hard to question stocking success. According to findings from previous research (von Lindern and Mosler, submitted, chapter VI), we can assume that the attitude towards stocking depends on the degree of compensatory thinking, which in turn depends on the functionality of stocking (among other factors). Thus, we can conclude that a very high attitude toward stocking derived from a very low degree of compensatory thinking (which we found in the present study) and an as high perceived functionality of stocking (which we also found with the anglers' high assumption of the share of stocked fish in their catch). When

linking these findings to the knowledge, that all participating fishing clubs conduct stocking for many years, we might assume that the underlying mental model has become very stable over time. From that point of view, the statement done by the members of FC 1 is feasible: 20 years of stocking experience cannot be wrong.

This leads us to the conclusion, that the intervention project should have been designed to elicit stocking success over a longer period of time, which would give the anglers more time to think about stocking success and more confidence in the results. However, we also observed problems to keep them interested and involved over repeated time-consuming fieldwork. This might counteract the advantages of longer ongoing fieldwork. Furthermore, we can conclude that a 'modify behaviour' message is the more promising approach compared to a 'stop behaviour' message, when aiming at changing mental models.

VII.5 Limitations

In the present study, we encountered severe problems regarding the data quality as well as the compliance of the fishing club members to participate in fieldwork or in reliably responding to recurring surveys, which was essential for our study design. Even though we found a way to deal with most of these problems, there are still some limitations that have to be mentioned.

First, the issue of low compliance and the low response rates was not only a problem for doing analyses according to the project design, but also for assessing intervention based changes. Even though we build three panels for analyses, the number of participants was very low especially for the modify stocking and stop stocking group (see table 3). Thus, only huge differences would become significant in any analyses.

A second limitation was, that the building of intervention groups could not follow a random assignment of participants to control or experimental groups. We had to work with fishing clubs as natural groups and therefore we could not ensure that all effects (significant or not) derived from project related impact. Furthermore, with this setting, we depended on biological stocking success results, preferable as clear as possible. However, outcomes in real-world environments cannot be planned, especially when interaction with complex systems like stream and river ecosystems. Therefore, it was impossible from a biological point of view, to communicate clear success or failure of the stocking experiments, and furthermore, to give clear reasons and explanations, why

stocking was a success or failure and how exactly fisheries management should be done. As Haertel-Borer and von Lindern (submitted, chapter IV) have pointed out, there is no general recipe applicable for every single river to ensure stocking success. Thus, the explanatory value, on which we based our intervention, suffered form uncertainty. Where strict explanations and results should be utilised for designing interventions, we had to rely on more or less vague ratings. Therefore, the impact-power of our interventions was much lower than it should be, which could have also impacted the credibility of the stocking results from the anglers point of view. What made intervention planning even harder was that we did not know the outcomes of the stocking success controls until the biological part of the project was analysed and the final reports could be created.

Additionally, the time frame was too short to deduct general stocking success. Perhaps, just more time was needed to collect clearer biological results and to falsify anglers' alternative explanations for failing in raising and supporting trout stocks due to stocking.

Another reason for failure in identifying intervention effect/success might be, that the surveyed anglers were not used to filling in questionnaires or in participating in scientific research projects. In some cases, we got hints that some rural anglers might be illiterates, which clearly indicates that eliciting metal models via questionnaire was the wrong approach. Instead, a more qualitative approach like open-ended theme-focussed interviews (Witzel, 2000) and the application of the structure laying technique (Scheele and Groeben, 1988, Groeben and Scheele, 2000) might have been fitted better into the angler context, as previous research by von Lindern et al. (submitted, chapter V) indicates.

VII.6 Future Research and Implications for Planning Interventions

The aim of the present study was to analyse, whether mental models derived tailored interventions are a powerful and promising approach to impact beliefs, attitudes and intentions toward promoting a pro-environmental ecosystem management. However, due to severe problems (see sections VII.4 Discussion, and VII.5 Limitations), we were not able to clearly answer this question within our present study. Nevertheless, we found very encouraging indications that mental models derived tailored interventions have the potential to indeed change beliefs and attitudes.

We are convinced that more research analysing the impact of mental models is worth the effort. Future research on this topic should be conducted in a more controllable environment. Also a stronger commitment of the participants would be preferable, as well as getting clearer (biological) results and fewer limitations. In general, eliciting mental models is still a challenge and further research is needed.

Overall, the mental models approach has to still prove being more effective than applying interventions in the conventional sense (e.g. creating brochures with general information on how to do stocking). Otherwise the effort of eliciting and analysing mental model will not be justifiable. However, the mental models approach is very powerful in gaining a deep understanding of the target populations' belief structure and predominant subjective theories, and furthermore, the theory-congruent results and tendencies found in the present study are promising results for future research in the field of mental models.

VIII. Summary of Results

This chapter provides an overview of the results found in chapters IV, V, VI and VII. Because these chapters were designed as stand-alone chapters, there are some overlapping results. Therefore some of the research questions presented in chapter II.4 will be combined in this summary. Nevertheless, it will also be indicated in which chapters details on these research question can be found.

VIII.1 Anglers' Mental Models of Trout, Trout Habitat Requirements and Impairments, and of Stocking

This subsection focuses on the research question 'What do anglers think and believe about trout and their habitat requirements and impairments?', 'What do anglers think and believe about fisheries management, with a special focus on stocking?', 'Where are the gaps between expert and angler knowledge regarding stocking and fisheries management?' detailed in chapter IV, and on 'What are the mental models of stream and river ecosystems and trout population dynamics of Swiss anglers?', which was assessed in chapter V.

In summary, the anglers who participated in the qualitative interviews and the SLT (stage I, N = 12) and in the Swiss-wide survey study (stage II, N = 418) had very detailed and complex mental models of trout, trout habitat requirements and impairments, and of stocking. The main result derived from the qualitative approach in stage I was the finding of the 13 key-concepts habitat, water quality, degree of naturalness, river morphology, food availability, (chemical) impairments of water quality, trout population size, natural reproduction of trout, fish health, stocking, conservation of local populations, predators, and fisheries management. Most participants in stage I mentioned these key-concepts as strong influence factors regarding processes in the stream and river ecosystem, with a focus on stocking and trout population size.

In the Swiss-wide survey study in stage II, theses key-concepts served as a basis for assessing the anglers' mental models in a larger population. The results showed that at least the anglers who responded to the survey had a very detailed and complex understanding of the stream and river ecosystem. With open-ended questions

constructed to elicit the most important positive and negative impact on the key-factors from stage I, a total of 7843 influencing factors were mentioned. These answers were categorised into 43 categories and were highly interconnected. To reduce complexity, only relations with an answer frequency ≥ 5% were taken into account. Of the categories, 9 were not related to any other concept and thus eliminated. Figure 35 summarises the resulting categories and their interrelations.

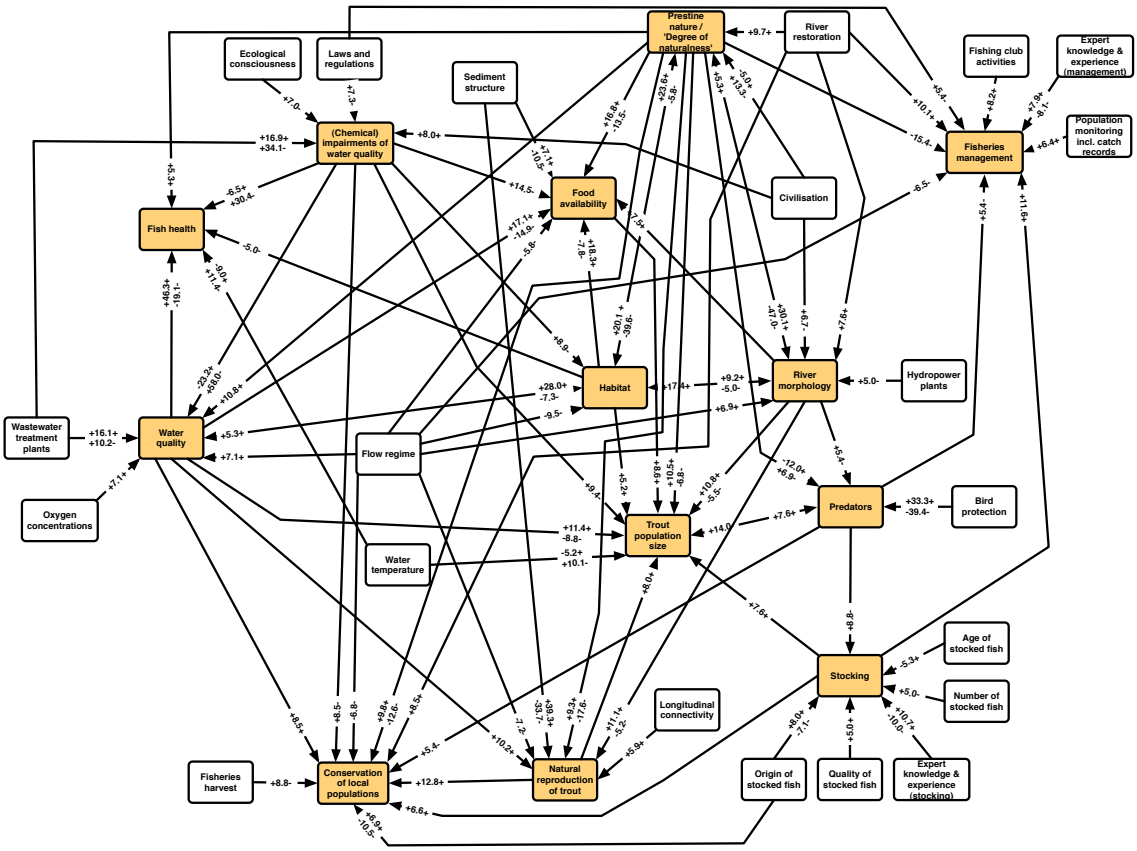

Figure 35. Mental model derived from the Swiss-wide survey in stage II. Highlighted concepts represent the 13 key-concepts from the qualitative approach in stage I, while the 21 white boxes represent additional concepts mentioned in the open-ended questions in the Swiss-wide survey. Only relations mentioned by ≥ 5 % of the anglers were taken into account. The percentages indicate how many anglers mentioned that relation as most impacting between concepts combined by arrows. 'a → +…+ → b ' = the more a, the more b; 'a → +…- → b' = the more a the less b; 'a → -…+ → b' = the less a the more b; 'a → -…- → b' = the less a the less b. (see text for details).

The arrows indicate which concept impacts which other concept. Each arrow is labelled with a percentage that provides information about how many percent of the anglers mentioned that particular relation as the *main impact factor* for the concept the arrow

points at. Additionally, the combination of '+' and '-' states whether an angler mentioned that more or a positive ('+') state of the concept impacts the target concept positively ('+') or negatively ('-'). For example, the arrow between 'stocking' and 'trout population size' is labelled '+7.6+', which means that 7.6 % of the anglers saw in stocking the most positive impact factor for the trout population size. Other combinations should be read as follows: 'a → +…- → b' = the more/better concept a, the less/worse concept b; 'a → -…+ → b' = the less/worse concept a, the more/better concept b and 'a → -…- → b' = the less/worse concept a, the less/worse concept b.

When comparing the anglers' mental models with expert knowledge, it could be concluded that the anglers in general were aware of the three factors that are considered as responsible for the decline in trout catches (habitat, fish health and fisheries management; Burkhardt-Holm et al., 2005). Overall, the anglers' mental models covered very well the experts' concepts.

VIII.2 Major Differences in Mental Models: Additive and Compensatory Beliefs

Summarising the research questions detailed in chapter IV ('Are there different subgroups within the angler population who differ significantly in their mental models of stocking?') and those of chapter V ('Which relations in the mental models indicate whether stocking is seen as the most preferred management tool?', 'Do anglers possess various mental models with regard to stocking?', and 'Do these different mental models have consequences for anglers' attitude toward stocking, preferences for management tools, and pro-ecological orientation?), two different mental models with respect to stocking could be identified. The first mental model was labelled as 'additive mental model' and stated basically that natural reproduction should be done independently of the degree of natural reproduction, while the other one was labelled 'compensatory mental model' and linked the need for stocking to the degree of sufficient natural reproduction. These different mental models could be identified in both the qualitative approach in stage I and in the Swiss-wide sample in stage II. Further analyses have shown that the attitude towards stocking, the intention to do stocking and diverse other psychological constructs differ between anglers with an additive and compensatory mental model, whereas the compensatory thinking anglers had a lower attitude and intention compared to the additive thinking ones. For example, regarding pro-ecological

orientation (Arlinghaus and Mehner, 2005) among other constructs, significant differences ($p < 0.05$) could be identified and indicated that the compensatory thinking anglers were more pro-ecological orientated than the additive thinking ones.

VIII.3 Additive and Compensatory Mental Models in the Frame of Attitude and Intention

Referring to the finding of an additive and a compensatory mental model, whereas the latter could be associated with more pro-environmental attitudes and beliefs about stream and river ecosystems, the relationship between the type of mental model, attitude and intention was analysed with a structural equation model. This addresses the research question from chapter VI 'Which constructs, domains and perceptions are responsible for the type of mental model an angler has?', 'How are the anglers' mental models related to attitude and intention as selected aspects from the theory of planned behavior?', and 'Which role do mental models play in building attitudes toward stocking and intentions to participate in stocking?'.

The structural equation model was based on the Swiss-wide survey data (stage II) and stated that the degree of compensatory thinking (measured on a five-point scale; high degree = compensatory mental model; low degree = additive mental model) significantly influences the attitude towards stocking, which in turn significantly impacts the intention to do stocking. The degree of compensatory thinking depended on the perceived state of the environment for the trout population size and on the perceived functionality of stocking (see chapter VI for details). Concordantly with mental models theory (e.g. Norman, 1983; Kaplan and Kaplan, 2009), the perceived functionality has been found to be dependent on the assumed need for stocking and previous experience with stocking. Thus, by testing these assumptions with a structural equation model, mental models (in this case: the anglers' mental models) could be linked to the psychological constructs attitude (toward stocking) and intention (to do stocking). Furthermore, it could be clarified that good and satisfying experience with stocking in combination with a high assumed need for stocking contributes to a high perceived functionality of stocking, which in turn leads to a low degree of compensatory thinking. The low degree of compensatory thinking led to a high attitude towards stocking, which resulted in accordance with Ajzen's (1991) assumption from the theory of planned behavior in a high intention to do stocking.

VIII.4 Changing Additive to Compensatory Mental Models Through Intervention

The last research question (chapter VII, 'Is mental models derived intervention suitable for changing beliefs, attitude, and intention toward stocking?') was assessed with a longitudinal intervention study and involved six Swiss fishing clubs. The results indicated that a participation in stocking success controls and detailed feedback on stocking success experiments were in general suitable to impact the anglers' attitude towards stocking, the degree of compensatory thinking, and the perceived functionality of stocking (in measures of the anglers' believed share of stocked fish in the catch). Although these changes were not significant, the found tendencies of change were concordant with theory. Additionally, a regression analysis validated the statement in the structural equation model that a low degree of compensatory thinking leads to a high attitude towards stocking (and vice versa).

Even though severe problems due to a poor panel data quality, the results from the intervention study demonstrated how intervention could be designed based on a prior analysis of mental models.

IX. Discussion

The implications derived from the above-reported results are manifold and there are numerous aspects worth discussing. While a detailed discussion of the particular findings can be found in chapters IV, V, VI and VII, this chapter focuses on the discussion of the results in the frame of the mental models approach presented in chapter II.2 and II.3. Therefore, it first thematises how well the chosen methods worked to elicit mental models (IX.1). Second, the role of functionality for intervention and stocking in the mental models framework is under scrutiny in chapter IX.2.

IX.1 Eliciting Mental Models: How Well Worked the Methods?

As pointed out in chapter III, the qualitative approach to mental models by conducting open-ended theme-focused interviews and by gathering data utilising a modified version of the SLT were the methods of choice to elicit mental models of trout, trout habitat requirements and impairments, and of stocking. Referring to the results derived by using these methods, it can on the one hand be concluded that they were very powerful in eliciting mental models. The open-ended theme-focussed interviews fitted the angler context very well: they were eager to share their experiences and their beliefs about aspects that were subject to the interview guideline. Furthermore, there was good indication that the anglers thematised their subjective beliefs and were not biased by the interview situation, because some of them even mentioned that they were involved in more or less illegal stocking activities. On the other hand, the analysis of the interview data was very time demanding and the unstructured guideline used in the open-ended theme-focused interview made collecting comparable results rather demanding. In one case, the interview went completely off-topic. Although the results in this case were interesting and covered the general problems associated with stocking and fisheries management, it was not possible to relate them to the results from the other interviews.
With respect to the modified version of the SLT, most anglers were first puzzled what they were meant to do. However, after a short instruction, the anglers in this study got excited in visualising what they believe of trout, trout habitat requirements and impairments and about stocking. Some of them even stated that the modified SLT helped them to better understand their own beliefs. But this general positive notion is also an indicator for a global problem regarding eliciting mental models. As Norman

(1983) has pointed out the process of eliciting mental models might create an *ad-hoc* mental model (in the sense of Markman and Gentner, 2001). Thus, the visualisation and direct task of combining elements and concepts might have resulted in another mental model than the angler usually relies on when discussing or participating in stocking related activities.

Morgan et al.'s (2002) recommendation to create a confirmatory questionnaire according to findings from a qualitative approach seems very feasible. But in the case of stocking it was not applicable because no generalised statements about what is right or wrong could be inferred from expert knowledge. Therefore, we had to develop another quantitative approach. Designing the questionnaires to elicit mental models was even more challenging, as the conducted pre-tests showed. While the qualitative approach was mostly of a narrative character, were the participants thematised what came to their mind, the questionnaires had to present topics in a certain order. Thus, it cannot be excluded that this paper-and-pencil questionnaire inherent characteristic (e.g. von Lindern, 2006) biased the results derived from the open-ended questions or that the surveyed anglers perceived hints from the closed items on what would be feasible to answer. Although assessing the categorised results showed that the questionnaires were suitable to collect mental models (see chapter IV, or figure 35 in chapter VIII.1), it can be inferred from the pre-tests that eliciting mental models via closed-items is still a challenge.

In summary, it can be concluded that eliciting mental models by the presented qualitative approach was well suited and that the quantitative approach managed to follow up on the qualitative results.

IX.2 The Role of Functionality for Changing Mental Models

The principle of functionality of mental models is essential for most mental model theories presented in chapter II.2 and even for intervention it likely is a key-player (see chapter II.3). For Kaplan and Kaplan (2009) it is crucial for survival, because everything that a person does depends on the underlying mental model. Norman (1983) observed that mental models evolve from non-functionality to functionality. This does not mean that they are 'true' in representing the target system, but that they may be perceived as 'true' from a person's point of view, thus following the 'principle of truth' mentioned by Johnson-Laird (2006). An intervention strategy by Breakwell (2001) recommends creating an informational and motivational basis that makes a target

population reject a prevalent mental model in favour of a new one. Although the functionality of a mental model is according to Norman (1983) a part of the mental model itself, it additionally can be considered as a quality criterion for the appropriateness of a mental model regarding problem solving or goal achieving. In the domain of stocking, mitigation for human-caused habitat perturbations, restoration and conservation of stocks, and harvest enhancement have been identified as main goals of anglers associated with stocking (Cowx, 1999; Arlinghaus et al., 2002; Holzer et al., 2003; Baer et al., 2007). When looking at the functionality of stocking in the samples from stage II (Swiss-wide survey) and III (Intervention study), it can be seen that the anglers in these samples attribute very high functionality to stocking (figure 36).

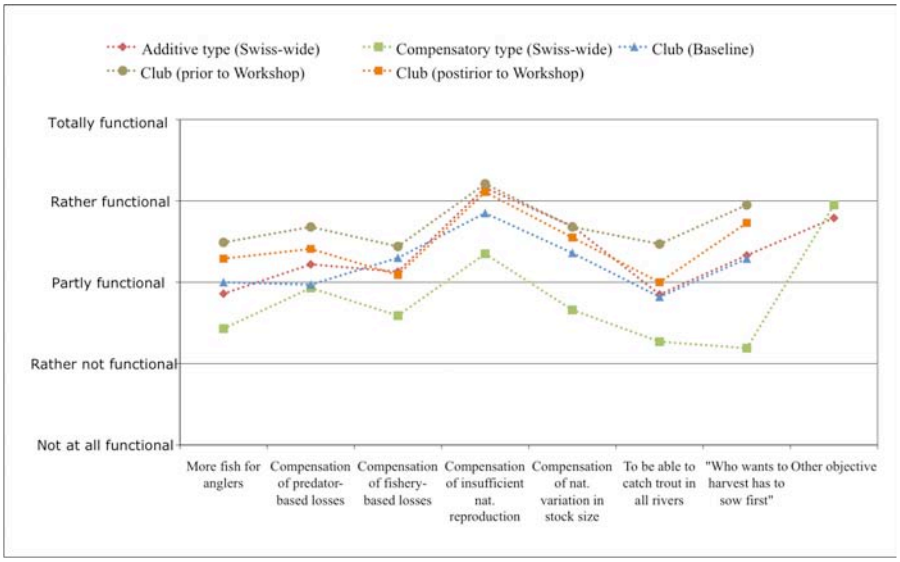

Figure 36. Perceived functionality of stocking for achieving different objectives. On display are the mean values derived from the Swiss-wide sample for the anglers with the additive and the compensatory mental model, and the means from the fishing club samples at T0, T2 and T3. The functionality was assessed on a five-point rating scale ranging from ‘not at all functional’ to ‘totally functional’. The category ‘other objectives’ has only been assessed in the Swiss-wide survey in stage II.

This descriptive finding emphasizes that stocking has a high functionality for the anglers surveyed in stage II and stage III. Except the compensatory thinking anglers from stage II, all surveyed anglers stated that stocking is at least partly functional for achieving different fisheries related goals (regardless of prior or posterior to intervention in stage III). Especially the almost similar characteristic of functionality between the samples in stage III (fishing club baseline, prior to workshop and posterior to workshop) indicates that the results from the stocking success experiments did not

impact the perceived functionality, and thus, there was no need for the anglers' mental models to evolve.

When looking at the criteria postulated by Norman (1983) that teaching materials for a target system must be learnable, functional and useable, it can be concluded that the compensatory beliefs have not been perceived as more functional regarding stocking as the beliefs inherited in the additive mental model. Alternatively, it might be that the functionality was unaffected by intervention because the anglers have not understood the compensatory model, or it is overwhelming for additive thinking anglers taking a variety of aspects into account when planning stocking. On the other hand, there were no significant differences between anglers with an additive and compensatory mental model in their level of education.

Another aspect regarding the functionality of stocking is that it might be that the above-mentioned motives for stocking are only the motives for stocking in a fisheries management context. This addresses the 'salience' dimension that, according to Breakwell (2001), defines the personal significance of a mental model. Thus, stocking might not only have personal significance for an angler in the context of fisheries management, but also in a social context, as indicated by the members of FC5 (see chapter VII.3.3.1). Following this, stocking is at least two-dimensional and thus has at least two aspects of functionality, which address completely different aspects: For the management-dimension, the degree of achieving the above-mentioned objectives might serve as a reference for functionality, but for the social dimension, the functionality of stocking might depend on e.g. how well it is suited to create a feeling of belonging together or to communicate that an angler cares for his river and its fishes. Other aspects derived from Kaplan and Kaplan's reasonable person model add even more dimensions to stocking: in their conception of 'being effective', Kaplan and Kaplan (2009) refer to the need for competence and give the example of a person who spends a lot of time and money on fine-tuning skills that have no importance for practice. This might also apply to the dimensionality of stocking functionality: Even if the (additive thinking) anglers agree that stocking is not necessarily functional for goal achieving from a fisheries management's point of view, they might perceive it as functional for increasing their skills regarding stocking and stocking related activity. Thus, keeping to stocking could satisfy their need for competence.

Following the assumption that stocking is likely to be multi-dimensional in its functionality, it is not surprising that intervention targeting at only the fisheries

management dimension could not significantly impact the functionality of stocking. On the other hand, at least the fisheries dimension should have been impacted, which was obviously not the case (figure 36). Again, referring to the theories in chapter II, Williams et al.'s (1983) assumptions and Breakwell's (2001) findings can be taken into consideration. According to Williams et al.'s (1983) theory of a mental model's structure, it was concluded that intervention has to decompose the targeted mental model, create relations to autonomous objects that inherit favoured beliefs (or characteristics) and thus enhance the original mental model by embedding the autonomous object with the favoured beliefs/characteristics. Referring to the functionality of stocking, it might be that the applied intervention was not powerful enough to decompose the mental model for stocking, and therefore not even the fisheries management dimension of stocking could be changed by embedding an autonomous object that inherits compensatory characteristics. Relating to Breakwell (2001), a further explanation might be that participation in the stocking success controls and attending the workshops did not increase the acceptance of the compensatory mental model for stocking. This means that the participating anglers accepted on the one side that the compensatory beliefs might be true and functional for some anglers, but rejected on the other side their validity and functionality with respect to their own rivers and situations. Evidence for this was found in the workshops, when some anglers agreed that e.g. stocking might be associated to risks in general, but that the way they do stocking is not.

Thus, the role of the dimensionality of a mental model's functionality and the dimensions of a person's relationship to a mental model are central to intervention planning aiming at changing mental models.

X. Strengths and Weaknesses

Looking at the aim of this research project to first elicit and then – if indicated – change anglers' mental models of stocking to promote a more pro-environmental fisheries management behaviour, it is clear that multiple aspects had to be considered. While details on particular limitations for answering the concrete research questions are given in chapters IV, V, VI and VII, this chapter will concentrate on the weaknesses and strengths of the present study from a more general perspective.

Overall, mental models are a very vast and wide research field, as the presented assumptions and theories in chapter II indicate. These theories cover topics from explaining how human reasoning works (e.g. Johnson-Laird, 1983, 2001, 2006), how risk communication can be designed (e.g. Morgan et al., 2002), how communication between stakeholders, lay-persons and experts could be enhanced (e.g. Kolkman, Kok, and van der Veen, 2005), how interventions could be planned (e.g. Breakwell, 2001) up to positioning mental models into the larger framework of analysing requirements for reasonable behaviour (Kaplan and Kaplan, 2009). The context in which mental models have been analysed – or utilised – is manifold. The mental model theories pointed out that mental models inherit understanding of the world and thus serve people to plan, anticipate and carry-out action. On the other hand, this central role of mental models made it very challenging to elicit these fundamental beliefs, especially when focussing on a complex system like the stream and river ecosystem with many interrelated aspects. This issue applies to mental models research in complex systems/environments in general and emphasises the problems discussed in chapter IX.2 that in some cases the dimensionality of a mental model (or of its functionality) is manifold. In combination with Norman's (1983) general limitation regarding the building of an *ad-hoc* mental model (in the sense or Markman and Gentner, 2001) just by asking about processes and beliefs, it is still an open question whether the mental models that people *really* rely on in a specific situation can be elicited outside the situation with interviews or questionnaires.

But nevertheless, the results in this study gave good indication that mental models at least impact the anglers' attitude towards stocking and derive from environment-based perception and assumptions (see chapter VI and VII). It thus can be concluded that even though interviews and questionnaires have limitations in eliciting situation-specific

mental models, they give evidence to be suitable for eliciting mental model that are associated with behavioural relevant psychological constructs.

A further and more severe weakness derived from the project design presented in chapter III regarding the project timeline. While it would have been preferable to first elicit mental models by the qualitative approach in stage I, second validate the mental models in the Swiss-wide survey (stage II) and *finally* design the intervention study in stage III based on findings from stage I and II, the stages were overlapping. However, the facts that the project funding expired after three years and that stocking is usually conducted in autumn made it almost impossible to start with the stocking success experiments *after* thoroughly analysing the data from stages I and II. The overlapping stages therefore resulted from a lack of time. Especially the development of the baseline questionnaire (stage III) suffered from this limitation, because it could have been reduced in content after analysing the findings from the Swiss-wide survey. Moreover, the whole planning of stage III could have been optimised according to results found in stage II, e.g. by additionally analysing the social dimension of stocking.

This – in matters of time – challenging project design reaches out to even more limitations. First, the interviews could have been analysed more thoroughly. They were just partially transcribed and key-topics were analysed, but it is likely that a more time demanding, qualitative analysis would have resulted in even more key-topics or relations among them. Second, with reference to the additive and compensatory mental model, a larger timeframe would have made it possible to develop a scale for assessing the degree of compensatory thinking instead of depending on a one-item-measurement, even though that item represented the most important difference between additive and compensatory mental models (see e.g. chapter VI).

Thus, approximately one more year would have been needed, so that the stocking success experiments would have started in late summer/autumn 2009 and lasted until autumn 2010, with the workshops and final reports in spring 2011.

Although these weaknesses are not ignorable, the present study has also major strengths. First of all, the finding of an additive and compensatory mental model of processes in the stream and river ecosystem with a focus on stocking contributes to a deeper understanding of anglers as stakeholders in fisheries management. This understanding is even further enhanced by the comparison of expert knowledge and anglers' beliefs (derived from their mental models) regarding stocking and trout habitat

requirements and impairments, as presented in chapter IV. Such a compilation of knowledge and beliefs can be utilised for enhancing communication regarding future stocking and management decisions between anglers as stakeholders, fisheries scientists and officials (e.g. cantonal delegates in Switzerland). Additionally, this study gives an excellent example of how far-reaching and promising the mental models approach is. For example, through analysing the relationships between the perception of the state of an environment, the assumed need for stocking, the perceived functionality and experience made with stocking and the degree of compensatory thinking, the mental models approach could be linked to selected constructs (namely attitude and intention) from the theory of planned behavior (Ajzen, 1991). Thus, empirical evidence for Kaplan and Kaplan's (2009) statement that 'people rely on them [their mental models] for everything they do' (p.330) could be found in this context.

In general, the assumptions and conclusion developed during analysing project stages I and II were replicable in stage III, where tendencies of change could be identified in concordance with assumptions from prior findings. Thus, it can be concluded that even though the timeframe was a strong, limiting factor for the development of methods, the methods were suitable for eliciting mental models.

A second major strength is the insights gained regarding the functionality of a mental model in the frame of intervention planning. Especially the possible multi-dimensionality of a mental model's functionality as discussed above (chapter IX.2) emphasizes the role of need satisfaction and of the dimensions defining a person's relationship to a mental model for intervention planning.

XI. Future Research & Implications for Practice

The overall findings presented and discussed in this dissertation showed – taking Swiss anglers and stocking as an example – that the mental models approach is very promising for gaining a deeper understanding of behaviour and that it is powerful for planning interventions. With the mental models approach, exact beliefs can be identified, and thus intervention can be tailored to change these particular beliefs. In this framework, the presented findings and limitations have implications for future research and practice in the fields of intervention planning, environmental psychology and fisheries research.

Regarding **intervention planning**, it has to be considered that targeting the functionality of a mental model is something different than targeting behaviour. A perceived loss of functionality (e.g. through experiences while participating in an intervention campaign) initiates an evolving process in the mental model (Norman, 1983), but leads not necessarily to an obvious change in behaviour. According to e.g. Kaplan and Kaplan's (2009) reasonable person model, a perceived loss in functionality will result in exploration, and thus aiming at gaining clear-headedness or understanding, which enables a person to anticipate events and, finally, to act reasonable. Thus, intervention targeting at changing mental models will change a person's understanding and worldview, which is likely to result in a corresponding change in behaviour, or in the case of successful intervention, increases the likelihood of showing the intervention-favoured behaviour. Because the role of functionality for a mental model is essential for the success or failure of intervention (see also chapter IX.2), future research should address the potential multi-dimensionality of functionality. Thus, before intervention can be designed and applied, it has to be analysed first how many dimensions the functionality of the mental model under scrutiny has. Then intervention should be tailored to impact the mental model's functionality regarding the most significant dimension it has for a person. This implies that e.g. planning to promote a more pro-environmental fisheries management must not necessarily target fisheries management. Moreover, it should first be identified for which domains the targeted behaviour is most functional. This is not always obvious, as Kaplan and Kaplan's (2009) link to the need for competence showed. Thus, keeping to the example of anglers and stocking, it might have been more successful to target the social dimension of stocking by implementing activities in the fishing clubs that are more functional than stocking for creating a feeling of belonging together or in demonstrating to the public that the anglers care for

their rivers and its fish. Of course, targeting all dimensions of functionality is most promising for a successful intervention.

Referring to the larger framework of **environmental psychology**, Kaplan and Kaplan's (2009) approach can be considered as being very promising in emphasising the role of mental models for reasonable behaviour in general, which can also be associated with pro-environmental behaviour (p. 330). However, the reasonable person model (Kaplan and Kaplan, 2009) still needs more empirical support and future research should address the exact relation between its three fundaments 'model building', 'being affective', and 'meaningful action'.

In this sense, this dissertation can be understood as a pilot study that utilised the mental models approach to promote a more pro-environmental fisheries management by examining the mental models of anglers as stakeholders, linking the mental models to the framework of behaviour explaining theories (chapter VI) and by developing and conducting a participative intervention based on the target groups' mental models.

On a more general level, based on the findings from theory and the experiences and results from this study, future research could aim at developing a more detailed conceptual model that describes what aspects of a mental model could be influenced by which interventions, and how the relations between a mental model and behaviour explaining theories can be defined.

With respect to **fisheries management**, the finding of an additive and a compensatory mental model has far-reaching implications. As the results have shown, the degree of compensatory thinking (which was used as an indicator whether an angler was allocated to the additive mental model = low degree of compensatory thinking or to the compensatory mental mode = high degree of compensatory thinking) was correlated with a variety of psychological dimensions (see chapter V and VI). Future research in fisheries management might thus follow up on theses findings and aim at analysing other stakeholders like cantonal fisheries managers using the approach presented in this study. By doing this, a framework for fisheries management might be developed according to the mental models of stocking for all involved stakeholders, and thus enhancing communication and understanding between different groups of stakeholders.

XII. Concluding Remarks

The aim of this research project was to first elicit and then – if indicated – change anglers' mental models of trout, trout habitat requirements and impairments and of stocking to promote more pro-environmental fisheries management behaviour. Overall, the project succeeded in eliciting these mental models and provides information suitable for intervention-planning. Thus, the mental models approach gave evidence to be powerful in providing deeper understanding of stakeholders' beliefs and management preferences. However, when looking at the aim to change mental models if indicated, the applied interventions were apparently not successful in lowering the perceived functionality or in changing the degree of compensatory thinking, even though tendencies of change in the hypothesised directions could be observed.

Nevertheless, referring to theory, possible reasons have been identified and discussed for the non-significant effects of intervention. From this it can be concluded that the chosen approach was very well suited to elicited anglers' mental models of stocking and to plan intervention according to the findings, but not all dimensions of the mental models (or their functionality) have been taken into account (e.g. the social dimension). Therefore, if future research addresses especially the multi-dimensionality of a mental model's functionality, intervention is likely to be very powerful. In the case of successfully questioning all relevant dimensions of the functionality of a person's mental model, the person's understanding of a target system will evolve according to new experiences (e.g. generated by exploration) and thus pro-environmental and reasonable behaviour can be fostered.

In summary, from the point of view of this research project, eliciting mental models and designing intervention according to pre-existing mental models is a very promising approach and is worth focussing on in future research.

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XIV. Appendix

XIV.1 Supplementary material used in stage I

XIV.1.1 Short questionnaire

Liebe Teilnehmerin, lieber Teilnehmer!

In Verbindung mit den Interviews möchten wir Sie bitten, uns die folgenden Angaben zu Ihrer Person und Ihren Angelgewohnheiten mitzuteilen. Selbstverständlich sichern wir Ihnen absolute Anonymität und den Schutz Ihrer Angaben zu. Wir behandeln Ihre Angaben streng vertraulich. Die Angaben benötigen wir lediglich für statistische Zwecke. Bei Fragen oder Unklarheiten zögern Sie bitte nicht, sich bemerkbar zu machen.

Vielen Dank!

a. Fragen zu Ihrer Person

In welchem Jahr sind Sie *geboren*?

Seit wie vielen Jahren *fischen* Sie?

In welchem bzw. welchen Kantonen fischen Sie regelmäßig?
(Mehrfachnennungen möglich)

☐ Zürich	☐ Bern	☐ Luzern	☐ Uri
☐ Schwyz	☐ Obwalden	☐ Nidwalden	☐ Glarus
☐ Zug	☐ Freiburg	☐ Solothurn	☐ Basel-Stadt
☐ Basel-Land	☐ Schaffhausen	☐ Genf	☐ Jura
☐ St. Gallen	☐ Graubünden	☐ Aargau	☐ Thurgau
☐ Tessin	☐ Waadt	☐ Wallis	☐ Neuenburg
☐ Appenzell-Innerrhoden		☐ Appenzell-Ausserrhoden	

Welchen höchsten, allgemeinbildenden Schulabschluss haben Sie?

○ keinen	○ obligatorische Schule	○ Gymnasiale Maturität
○ Fachmaturität	○ Berufsmaturität	

○ Ich habe einen anderen Abschluss, und zwar: _____

Welchen Beruf üben Sie zurzeit aus? (Mehrfachnennungen möglich)

☐ SchülerIn	☐ Zivildienst	☐ AngestellteR
☐ StudenIn	☐ RenterIn/ PensionärIn	☐ leitd. AngestellteR
☐ AuszubildendeR	☐ Hausfrau/mann	☐ BeamteR
☐ Militärdienst	☐ SelbstständigeR	☐ leitd. BeamteR
☐ ArbeiterIn	☐ FacharbeiterIn	☐ ohne Arbeit

☐ Sonstiges, und zwar: _____

Mein Berufsfeld ist eher...

○ technisch-handwerklich	○ wissenschaftlich	○ künstlerisch
○ pädagogisch	○ kaufmännisch	○ sonstiges:_____

In meinem Haushalt wohnen ____ Personen. Davon sind ____ Personen Angler.

Welches ist die Sprache, in der Sie denken und die Sie am besten beherrschen?

○ deutsch ○ französisch ○ italienisch ○ rätoromanisch

○ andere, und zwar: _____

b. Fragen rund um das Fischen:

Was ist beim Fischen wichtig für Sie? Welche Aussage entspricht am *ehesten* Ihrer Einstellung?

○ Wichtig ist der Fang kapitaler Fische	○ Wichtig ist es, viele Fische zu fangen
○ Wichtig ist es, viele Fische mitzunehmen	○ Auch ohne Fang ist ein Angeltag gut

Wie viele Gewässer befischen Sie regelmäßig? _____

Was sind Ihre bevorzugten Fischarten? _____

Wie lange halten Sie sich durchschnittlich während eines Angelausflugs an Ihrem Angelgewässer auf?
○ weniger als 3 Stunden ○ 3 – 5 Stunden ○ 5 – 7 Stunden ○ mehr als 7 Stunden

An wie vielen Tagen gehen Sie im Jahr durchschnittlich angeln?
○ weniger als 10 ○ 10 – 19 ○ 20-29 ○ 30-39 ○ 40 – 49 ○ 50 und mehr

Welche Fischarten fangen Sie am häufigsten? _____

Wie viele Fische fangen Sie durchschnittlich pro Angelausflug?
○ keine ○ 1 – 3 ○ 4 – 6 ○ 7 – 9 ○ 10 – 12 ○ mehr als 12

Welche der folgenden Angeltechniken wenden Sie an?
(Mehrfachnennungen möglich)

☐ Fliegenfischerei
☐ Spinnfischerei
☐ Fischerei mit Naturködern
☐ Sonstiges, und zwar: _____

Wie wichtig ist für Sie die Güte der Angelausrüstung?
○ wichtig ○ eher wichtig ○ eher unwichtig ○ unwichtig

Wenn Sie sich über wichtige Themen für das Fischen informieren... welche Quellen nutzen Sie? (Mehrfachnennungen möglich)
☐ Fachzeitschriften
☐ Presse
☐ Vereinszeitung
☐ befreundete Angler
☐ Fernsehen
☐ Informationsveranstaltungen des Vereins
☐ Informationsveranstaltungen außerhalb des Vereins
☐ andere Vereinsmitglieder
☐ Seminare und Workshops
☐ Internet
☐ Sonstiges, und zwar: _____

Insgesamt bin ich mit dem Fischen derzeit...
○ sehr zufrieden ○ eher zufrieden ○ eher unzufrieden ○ sehr unzufrieden

c. Vereine

Sind Sie Mitglied in einem Fischereiverein? ○ ja ○ nein → **weiter bei d)**

Seit wie vielen Jahren sind Sie bereits im Verein? _____

Wie häufig beteiligen Sie sich an folgenden *Vereinsaktivitäten*?	immer	oft	selten	nie	Gibt es bei uns nicht
Jungfischerausbildung	○	○	○	○	○
Mithilfe bei Vereinsanlässen	○	○	○	○	○
Abfischung	○	○	○	○	○
Besatz	○	○	○	○	○
Aufzucht	○	○	○	○	○
Sonstiges, und zwar: _____	○	○	○	○	○

Hat der Verein eine eigene Aufzuchtanlage? ○ ja ○ nein

d. Fragen zur Gewässerbewirtschaftung

Findet Fischbesatz in Ihrem hauptsächlich genutzten Gewässer statt? ○ ja ○ nein

Wenn „**ja**“, welche Fischarten und Altersklassen/Grössen werden in Ihrem hauptsächlich genutzten Gewässer besetzt? _____ _____

Wie schätzen Sie Besatz im Allgemeinen als Bewirtschaftungsmethode ein?
○ sehr gut ○ eher gut ○ eher schlecht ○ sehr schlecht

Unabhängig vom Verein: An welchen der folgenden Arbeiten an Gewässern sind Sie aktiv beteiligt? (Mehrfachnennungen möglich)

☐ Besatz
☐ Laichfischfang
☐ Fischaufzucht
☐ Abfischungen
☐ Aufzuchtbäche
☐ Bachputzete
☐ Sonstiges, und zwar: _____

Wie beurteilen Sie die Bewirtschaftungsmaßnahmen an Ihrem Angelgewässer?
○ sehr gut ○ eher gut ○ eher schlecht ○ sehr schlecht

e. Allgemeines

Inwiefern stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Der Großteil meines Freundeskreises besteht aus Fischern	○	○	○	○
Ich bin ein erfahrener Fischer	○	○	○	○
Fischen ist mein wichtigstes Hobby	○	○	○	○
Das Fischen ist ein wichtiger Bestandteil meines Lebens	○	○	○	○
Ich genieße Anbiss und Drill des Fisches	○	○	○	○
Beim Fischen habe ich das Gefühl, in der Natur aufzugehen	○	○	○	○
An den Plätzen, an denen ich fische, gibt es viel zu entdecken	○	○	○	○
Das Fischen ist mir eine willkommene Abwechselung zur Alltagsroutine	○	○	○	○
Die Umgebung/Natur fasziniert mich beim Fischen	○	○	○	○
Vereinsaktivitäten wie geselliges Beisammensein, Unternehmungen in der Natur etc. machen mir genau so viel Spaß wie das Fischen selber	○	○	○	○

Vielen Dank für Ihre Angaben!

XIV.1.2 Interview Guideline

Einführung:
Außerhalb der theoretischen, so genannten objektiven, wissenschaftlichen Theorien wollen wir individuelle, subjektive – also persönliche Vorstellungen und Erfahrungen – erfragen, um damit die wissenschaftlichen Befunde zu bereichern, aber auch um sie zu hinterfragen. Deswegen werde ich Ihnen eine ganze Reihe sehr grundlegender Fragen stellen, aber auch ab und zu provokant weiterfragen. Nehmen Sie dass dann bitte nicht persönlich, aber kritisches Hinterfragen ist eine wichtige Methode, um persönliche Vorstellungen und Erfahrungen genauer zu verstehen. Ich werde die kritischen Fragen jeweils mit dem Zusatz „Störfrage“ o. Ä. versehen.

Leitfragen für das Interview:

a) = allgemeine Fragen zum Konzept, Definitionen
b) = Fragen zu Wirkungen, Zusammenhängen und Erklärungen
c) = Störfragen (Werden jeweils als kritische Störfrage eingeführt!)

I. Allgemein, Verhalten und Intention
I.1a) Warum angeln Sie? Was hat Sie dazu veranlasst, mit dem Angeln anzufangen?
I.2a) Was bedeutet Angeln für Sie?

II. Allgemeines, Angelplatz:
II.1a) An was für Gewässern fischen Sie hauptsächlich? (Größe, Art,...)
II.2a) Wovon lassen Sie sich bei der Wahl Ihres Angelplatzes leiten?
II.3a) Wie zufrieden sind Sie insgesamt mit dem Gewässer, an dem Sie hauptsächlich angeln?
II.4a) Ist das eigentlich ein Patent- oder Pachtgewässer?

III. Ökosystem:
III.1a) Können Sie mir ganz spontan sagen, was Sie unter dem Begriff „Umweltsystem Fließgewässer“ verstehen?
III.2a) Was sind aus Ihrer Sicht die Hauptunterschiede zu anderen Umweltsystemen?
III.3a) Wie funktioniert ein Fließgewässer? Was zeichnet ein Fließgewässer aus? Was muss alles vorhanden sein, damit das Umweltsystem funktioniert bzw. intakt ist?
III.4b) Wie beeinflussen sich die verschiedenen „Zutaten“/Bestandteile des Umweltsystems gegenseitig?
III.5b) Welche Funktionen erfüllen die von Ihnen gerade genannten „Zutaten“/Bestandteile?
III.6c) Da muss ich jetzt aber einmal kritisch nachfragen: Gilt das, was Sie gerade gesagt haben nicht nur für das Fließgewässer, an dem Sie angeln? Oder ist das wirklich verallgemeinerbar?
III.7b) Wie kann von Außen auf ein Fließgewässer Einfluss genommen werden? An welchen Stellen ist ein Fließgewässer „angreifbar“?

IV. Modellvorstellungen:
IV.1b) Gedankenexperimente:
Welche Auswirkungen auf das Umweltsystem „Fließgewässer“ hat es, wenn...
- die Wassertemperatur abnimmt/zunimmt?
- die Anzahl der fischfressenden Vögel abnimmt/zunimmt?
- Die Fische sich schlagartig vermehren/ sich nicht mehr vermehren?

- Strömung zunimmt/ abnimmt?
- Der Wasserpegel sich schnell verändert?
- Der Zufluss oder Abfluss sich schnell ändert?
- Der Flusslauf begradigt/renaturiert wird?

V. Fischereiliche Situation/ Bewirtschaftung:

V.1a) Können Sie mir ganz spontan sagen, was für Sie „Bewirtschaftung von Fließgewässern" ist?

V.2a)Wenn Sie die fischereiliche Situation in einem Fließgewässer bewerten sollten, was sind dann die wichtigsten Dinge, auf die Sie achten würden?

V.3b) Können Sie mir erklären, ob und wie diese Dinge zusammenhängen?

V.4a) Wie bewerten Sie die fischereiliche Situation in der Schweiz?

V.5a) Wie wird die fischereiliche Situation in der Schweiz von der Mehrheit Ihres persönlichen Umfeldes bewertet?

V.6a) Wie bewerten Sie die fischereiliche Situation in Ihrem Angelrevier?

V.7a) Wie wird die fischereiliche Situation in Ihrem Angelrevier von der Mehrheit Ihres persönlichen Umfeldes bewertet?

V.8b) Was denken Sie? Hat die Angelfischerei das Potenzial, Fischbestände durch Entnahme, fischereiliche Aktivität etc. zu beeinflussen? Wie wirkt sich eine Beeinflussung aus bzw. warum gibt es keine Beeinflussung?

V.9c) *Falls V.8b) = kein Potenzial:*

Aber jetzt einmal böse gefragt... dann ist es also egal, wie viele Fische Sie und andere Fischer angeln?

Falls V.8b) = hat Potenzial:

Ja? Ich kann mir gar nicht vorstellen, dass das Fischen solche Auswirkungen haben soll. Ist das nicht eher so, dass sich das Gewässer selbst reguliert, egal wie viel man fischt?

V.10b) Worüber ärgern Sie sich eigentlich am meisten, wenn Sie fischen? Warum ist das zum Ärgern?

V.11b) Und was freut Sie am meisten, wenn Sie fischen?

V.12b) Was würden Sie ändern, wenn Sie eine Sache an der Bewirtschaftung Ihres Angelgewässers verändern könnten? Warum das?

VI. Renaturierung, Umwelt:

VI.1b) Hat sich eigentlich das von Ihnen hauptsächlich befischte Gewässer in den letzten Jahren verändert? Was ist anders geworden? Warum gab es Ihrer Meinung nach diese Veränderung? Oder ist das Gewässer „stabil"?

VI.2a) Was ist eigentlich „gutes Wasser" für Fische/Bachforellen? Gibt es bestimmte Inhaltsstoffe, die wichtig sind?

VI.3b) Von welchen Veränderungen am Gewässer und/oder Ufer würden Fischbestände am meisten profitieren? Warum?

VI.4b) Was bewirken Renaturierungen eigentlich?

VI.5a) Was sind gute Renaturierungsmaßnahmen?

VI.6b) Wenn (Renaturierungs-) Maßnahmen durchgeführt werden, wie schnell „greifen" diese eigentlich? Was meinen Sie, wann sind die Effekte zu bemerken? Was beeinflusst die Zeit?

VI.7c) Es zeigt sich ja immer wieder, dass der Mensch nicht wirklich „Herr über die Natur" ist. Warum kann man dann nicht einfach das Gewässer sich selbst überlassen, wenn (weil) die Natur schon einen Weg findet, sich anzupassen?

VII. Fischbiologie/ Lebensraum:

VII.1a) Was beeinflusst die Anzahl der in einem Fließgewässer lebenden Fische?

VII.2a) Was sind denn eigentlich natürliche Sterberaten, also vom Ei zur ausgewachsenen Bachforelle? Und welche Sterberaten sind bei einer ausgewachsenen Bachforelle normal?

VII.3a) Finden Sie das hoch oder niedrig?

VII.4b) Wirkt sich die Sterberate auf die Fischgesamtheit aus?

VII.5a) Was denken Sie, wo im Leben einer Bachforelle kritische Phasen sind? Was ist daran kritisch?

VII.6a) Unter welchen Bedingungen können Bachforellen ihren Lebenszyklus vollenden?

VII.7b) In welcher Lebensphase ist die Sterblichkeit der Bachforelle besonders hoch? Warum?

VII.8b) Welche Phasen der Entwicklung einer Bachforelle sind besonders anfällig für Eingriffe, zum Beispiel durch den Menschen? Warum?

VII.9b) Wie schätzen Sie die Bedeutung der Naturverlaichung in dem Gewässer ein, das Sie hauptsächlich befischen? Warum?

VII.10 b) Wie sieht aus Ihrer Sicht der ideale Lebensraum für Bachforellen aus? Was ist wichtig? Was ist nicht wichtig? Wie hängen die einzelnen Dinge zusammen?

VII.11b) Wie wichtig ist die Größe des Elterntierbestands in einem Fließgewässer? Warum ist diese wichtig bzw. vernachlässigbar?

VII.12a) Haben Sie schon einmal den Begriff „Flaschenhals-Konzept“ gehört? Was könnte es damit in Bezug auf die Entwicklung und Größe des Fischbestandes auf sich haben? Wie kann man sich das vorstellen?

VII.13b) Beeinflussen sich eigentlich Bachforellen unterschiedlichen Alters? Oder spielt es für die ausgewachsenen Tiere keine Rolle, wie viele junge Tiere da sind bzw. umgekehrt?

VIII. Besatz:

VIII.1a) Was ist ein guter Besatzfisch?

VIII.2a) Wo stammt eigentlich ein „guter“ Besatzfisch her?

VIII.3b) Wie wichtig ist die Herkunft eines Besatzfisches für das Überleben des Fisches? Warum spielt die Herkunft ein bzw. keine Rolle?

VIII.4c) Aber unterscheiden sich den Fische wirklich dadurch, wo sie herkommen? Ist es denn nicht egal, ob eine Bachforelle aus dem Fluss oder aus Kanada kommt? Ich meine, Bachforelle ist doch gleich Bachforelle, oder?
(Unterscheiden sich Besatzfische von angestammten Fischen? Wenn ja, wodurch?)

VIII.5a) Welches Alter hat ein „guter“ Besatzfisch?

VIII.6a) Was denken Sie, wie viele Fische besetzt werden sollten? Gibt es da ein bestimmtes, richtiges Maß?

VIII.7a) Wie würden Sie „guten, sinnvollen Besatz“ beschreiben?

VIII.8c) Es ist ja auch denkbar, dass Besatz nicht gut und unsinnig ist oder gar negative Folgen haben kann. Oder ist Besatz immer nur positiv?

VIII.9b) Was wären jeweils die Rahmenbedingungen, also die Voraussetzungen, für guten, sinnvollen Besatz?

VIII.10b) Wie würde sich das wohl auf ein Fließgewässer auswirken, wenn Fischbesatz eingestellt werden würde? Oder umgekehrt, wenn in einem Fließgewässer ohne Besatz mit Besatz begonnen werden würde? Bitte beschreiben Sie mir einmal,

welche Auswirkungen zu erwarten sind und warum diese Auswirkungen eintreten können.

VIII.11b) Was ist eigentlich aus Ihrer Sicht das wichtigste Ziel von Besatz? Warum wird das gemacht? (welche Defizite werden ausgeglichen?)

VIII.12b) Und was ist die genaue Wirkung von Fischbesatz? Können Sie das einmal an einem Beispiel erläutern?

VIII.13b) Welche Erfahrungen haben Sie bisher mit Fischbesatz gemacht? Wie erklären Sie sich diese?

VIII.14c) Jetzt würde mich aber folgendes noch einmal interessieren: Wenn man eine Bachforelle an der Angel hat, kann man dann noch erkennen, ob es sich um einen Besatzfisch handelt oder nicht?

VIII.15b) Welche Alternative könnte es zum Besatz geben? Was ist daran besser oder schlechter?

XIV.1.3 Structure-Laying-Technique

Während des Interviews haben Sie ja schon sehr viel zu Ihren Vorstellungen zum Ökosystem Fließgewässer gesagt. Ich habe hier einige Kärtchen und etwas zu schreiben mitgebracht und möchte Sie nun bitten, mir zusammenhängend darzustellen, was alles zu dem Umweltsystem Fließgewässer (Besatz, Fischbestand) gehört und in welcher Beziehung die „Bausteine“ zueinander stehen bzw. den Bachforellenbestand beeinflussen.
Was sind denn die Hauptbestandteile des Umweltsystems „Fließgewässer“?

- Wenn nichts kommt, Begriffe vorschlagen, die während des Interviews aufgetaucht sind.
- Wie würden Sie denn die Beziehung zwischen X und Y beschreiben?
- Ist das hier jetzt das wichtigste für das Umweltsystem, oder haben wir da noch etwas vergessen? (Bei Fehlen wichtiger, bereits genannter Begriffe: Wie verhält es sich denn mit XY? Wie passt das hier noch rein?)

Situationsbeschreibungsbogen (nach der Datenerhebung vom Interviewer/Interviewerin auszufüllen)

Wohnort:
○ Land ○ Dorf ○ Stadt

Geschlecht:
○ männlich ○ weiblich

Stimmung während des Gesprächs:

Verfassung der Interviewten Person:

Verfassung des Interviewers:

Besonderheiten, Störungen, Auffälligkeiten etc.:

Mögliche Relationen für die Konzepte in der SLT (nach Scheele und Groeben, 1988).

1. A ist notwendige Vorraussetzung für B:
A <vorraus. B

2. A ist Intention/Ziel/Zweck von B:
A <Absicht B

3. A ist ein Beispiel für Konzept B:
B ----Manifestation-----> A

4. A ist ein Symptom für Konzept B:
B ----Indikator----> A

5. A ist gleichbedeutend mit B:
A = B

6. B, C, D und E sind Unterkonzepte von A

7. A verursacht B; je größer A desto größer B:
A_+ -----> B

8. A verursacht B; je größer A desto kleiner B:
A_- -----> B

9. Gegenseitige Abhängigkeit von A und B; je größer A desto größer B desto größer A:
A_+ <-------> B

10. Gegenseitige Abhängigkeit von A und B; je größer A desto kleiner B desto größer A:
A_- <-------> B

11. Bis zu einer bestimmten Ausprägung: je größer A desto größer B. Danach: je größer A desto kleiner B:
A_+---∩--->B

12. Bis zu einer bestimmten Ausprägung: je größer A desto kleiner B. Danach: je größer A desto größer B:
A_+---∪--->B

13. Je größer A desto größer B. Aber nur, wenn C vorliegt:
$A\ ^+|C|_+$---->B

14. Je größer A desto größer B. Aber nur, wenn C nicht vorliegt:
$A\ ^-|C|_+$---->B

15. Je größer A desto kleiner B. Aber nur, wenn C vorliegt:
$A\ ^+|C|_-$---->B

16. Je größer A desto größer B. Aber nur, wenn C nicht vorliegt:
A ¯|C|.---->B

17. A beeinflusst C positiv, wenn B gegeben ist und negativ, wenn B nicht gegeben ist.
A +/-|B|+/- x== C

18. A beeinflusst C positiv, wenn B nicht gegeben ist und negativ, wenn B gegeben ist.
A -/+|B|+/- x== C

Konzeptkarten, die ohne Relation nahe beieinander liegen, sind zusammengehörig.

XIV.2 Supplementary material used in stage II

XIV.2.1 Questionnaire

Liebe Fischerin, lieber Fischer,

vielen Dank für Ihr Interesse an unserer Umfrage! In dem vor Ihnen liegenden Fragebogen haben wir verschiedene Fragen rund um Fische, Fliessgewässer und Bewirtschaftung zusammengestellt.

Warum diese Befragung?
Bisher gibt es kaum Studien, die die umfangreichen Erfahrungen und das Wissen von Fischern mit wissenschaftlichen Ergebnissen und Theorien in Verbindung bringen.
Genau dies haben wir uns aber mit dieser Befragung vorgenommen!
Daher würden Sie uns sehr helfen, wenn Sie uns bei dieser „Pionierarbeit" unterstützen und sich nicht von der Länge des Fragebogens (Bearbeitungsdauer ca. 60 Min.) abschrecken lassen. Als kleines „Dankeschön" für Ihre Mühen möchten wir Ihnen gerne eine Rückmeldung Ihrer Angaben zukommen lassen, aus der Sie ersehen können, welcher „Anglertyp" Sie sind. Wir nutzen Ihre persönlichen Angaben nur für die Rückmeldung, die Auswertung erfolgt selbstverständlich vollständig anonymisiert!

Insgesamt besteht der Fragebogen aus 4 Teilen:

1. Angaben zu Ihrer Person
   (Die Angaben zu Ihrer Person benötigen wir aus rein statistischen Gründen.)
2. Fragen zu Ihren Erfahrungen beim und Vorstellungen zum Fischen, Fliessgewässern und deren Bewirtschaftung
3. Allgemeine Fragen zu den Themen Natur, Vereine etc.
4. Ihre Anregungen, Fragen und Rückmeldungen zu dieser Befragung

Was erwartet Sie in diesem Fragebogen?

- Bei sehr vielen Fragen können Sie einfach ankreuzen, was am ehesten Ihrer Meinung entspricht. Wenn „Mehrfachnennungen möglich" zusätzlich bei der Frage steht, können Sie mehrere zutreffende Antworten auswählen.
- Wenn Sie eine Frage ohne Antwortvorgaben beantworten, reichen uns Stichworte aus.
- Bei einigen Fragen finden Sie die Antwortmöglichkeit „Weiss nicht". Hier bitten wir Sie, diese Antwort nur zu wählen, wenn Sie wirklich keinerlei Vorstellung oder Idee zur Beantwortung der Frage haben.
- Ein grosser Teil der Fragen behandelt das Thema Fischbesatz und Bewirtschaftung.

Eine Bitte haben wir noch an Sie:

- Beantworten Sie den Fragenbogen bitte vollständig und so, wie es Ihnen spontan in den Sinn kommt. Nicht ganz ausgefüllte Fragebögen sind für uns nur sehr schwer auszuwerten.

Was passiert mit den Ergebnissen?
Wir werden die Fragebögen per Computer erfassen und auswerten, um ein Gesamtbild der Schweizer Fischerinnen und Fischer hinsichtlich ihrer Erfahrungen und Meinungen zu Themen rund um das Fischen, Fischbestände und deren Bewirtschaftung zu erhalten. Besonders interessiert uns, durch welche Erfahrungen Fischerinnen und Fischer – als Expertinnen und Experten – Vorstellungen und Wissen über das Fischen aufbauen. Die ersten Ergebnisse dieser Studie können Sie ab Februar/März 2009 im Internet unter http://www.fischer.eawag.ch finden oder treten Sie einfach mit uns in Kontakt, dann senden wir Ihnen die Ergebnisse auch gerne schriftlich zu.

Bereits jetzt möchten wir uns für Ihre Teilnahme an dieser Befragung herzlich bedanken!

gez.
Eike von Lindern Susanne Haertel-Borer

Teil 1: Statistische Angaben

In diesem ersten Teil möchten wir etwas über Sie erfahren. Ihre Angaben benötigen wir für rein statistische Zwecke.

1) In welchem Jahr sind Sie *geboren*? [ ]

2) Vor wie vielen Jahren haben Sie mit dem *Fischen* begonnen? [ ]

3) Welchen höchsten Schulabschluss haben Sie?

○ keinen
○ obligatorische Schule
○ Berufslehre, Berufsschule, Berufsmaturität
○ Maturitätsschule, Lehrerseminar oder vergleichbar
○ höhere Berufsausbildung (Meisterdiplom, eidg. Fachausweis, HTL, Fachhochschule etc.)
○ Universität, Hochschule
○ Ich habe einen anderen Abschluss, und zwar: _____

4) Welchen Beruf üben Sie **zurzeit** aus? (Mehrfachnennungen möglich)

☐ Schüler/in	☐ Militärdienst	☐ Arbeiter/in
☐ Student/in	☐ Zivildienst	☐ Facharbeiter/in
☐ Auszubildende/r	☐ Renter/in, Pensionär/in	☐ momentan ohne Arbeit
☐ Hausfrau/mann	☐ Angestellte/r	☐ Sonstiger Beruf,
☐ Selbstständige/r	☐ leitd. Angestellte/r	und zwar:

5) Mein Berufsfeld ist eher...

○ technisch-handwerklich ○ wissenschaftlich ○ künstlerisch ○ pflegerisch
○ pädagogisch ○ kaufmännisch ○ sonstiges:_____

6) In meinem Haushalt wohnen ausser mir [ ]Personen. Davon sind ausser mir [ ] Personen Fischer.

7) Welches ist die Sprache, in der Sie denken und die Sie am besten beherrschen?

○ deutsch ○ französisch ○ italienisch ○ rätoromanisch
○ andere, und zwar: _____

8) In welcher Gegend wohnen Sie?

○ auf dem Land
○ Vorstadt/Stadtrand oder Kleinstadt
○ Stadt

9) Ich bin...

○ weiblich
○ männlich

10) In welchem bzw. welchen Kantonen fischen Sie regelmässig? (Mehrfachnennungen möglich)

☐ AG	☐ GE	☐ OW	☐ UR
☐ AR	☐ GL	☐ SG	☐ VD
☐ AI	☐ GR	☐ SH	☐ VS
☐ BL	☐ JU	☐ SO	☐ ZG
☐ BS	☐ LU	☐ SZ	☐ ZH
☐ BE	☐ NE	☐ TG	
☐ FR	☐ NW	☐ TI	

11) Ich nutze *hauptsächlich*...

○ Pachtgewässer ○ Privatgewässer
○ Patentgewässer ○ Gewässer mit Freiangelrecht

12) Wie häufig fischen Sie an folgenden Gewässern?	immer	oft	manchmal	selten	nie
Bäche & kleine Flüsse	○	○	○	○	○
Flüsse	○	○	○	○	○
grosse Seen	○	○	○	○	○
Weiher & kleine Seen	○	○	○	○	○
Andere Gewässer:_____	○	○	○	○	○

13) Wie viele Gewässer befischen Sie regelmässig?	[ ]
14) An wie vielen Tagen gehen Sie im Jahr durchschnittlich fischen?	[ ]

15) Welche der folgenden Angeltechniken wenden Sie an? (Mehrfachnennungen möglich)
☐ Fliegenfischerei ☐ Spinnfischerei ☐ Fischerei mit Naturködern ☐ anderes, und zwar:_____

Teil 2: Ihre Erfahrungen mit dem Fischen, Fliessgewässern und deren Bewirtschaftung

Der zweite Teil dieser Befragung ist am umfangreichsten. Damit Ihnen die Beantwortung so einfach wie möglich ist, haben wir die folgenden Fragen in verschiedene Themen unterteilt.

Thema: Lebensraum Fliessgewässer

Auf der nächsten Seite geht es mit Fragen los, bei denen wir gerne von Ihnen wissen möchten, was aus Ihrer Sicht und Ihren Erfahrungen alles wichtige Einflussgrössen für verschiedene Bereiche rund um Fische, Fliessgewässer und Bewirtschaftung sind.

Schreiben Sie bitte jeweils die 3 wichtigsten Einflüsse als Stichworte in die Felder. Es interessiert uns hier Ihre ganz persönliche Meinung und nicht, ob die Antworten richtig oder falsch sein könnten.

Falls Sie zu einem Bereich gar keine Vorstellung haben, kreuzen Sie bitte „Weiss nicht“ an.

16) Was wirkt sich nach Ihrer Meinung am stärksten auf die folgenden Bereiche aus? Bitte nennen Sie uns die 3 aus Ihrer Sicht wichtigsten Einflussfaktoren, die jeweils **gut, förderlich bzw. positiv** für den **jeweiligen Bereich** sind.		
Am förderlichsten für den Lebensraum von Bachforellen sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für die Wasserqualität von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für die Naturnähe von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für die Strukturvielfalt von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für das Nahrungsangebot für Bachforellen sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Der Anteil chemischer Stoffe im Fliessgewässer wird erhöht durch...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für Bachforellenbestände sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für Naturverlaichung sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am förderlichsten für die Fischgesundheit sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Hier haben Sie Platz, einen für Sie wichtigen Bereich zu nennen, falls wir diesen vergessen haben: Am förderlichsten/positivsten für.... sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht

17) Bitte nennen Sie uns nun die 3 aus Ihrer Sicht wichtigsten Einflussfaktoren, die jeweils **schlecht, hinderlich bzw. negativ** für den **jeweiligen Bereich** sind.		
Am beeinträchtigsten für den Lebensraum von Bachforellen sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für die Wasserqualität von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für die Naturnähe von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für die Strukturvielfalt von Fliessgewässern sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für das Nahrungsangebot für Bachforellen sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Der Anteil chemischer Stoffe im Fliessgewässer wird verringert durch...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für Bachforellenbestände sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für Naturverlaichung sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Am beeinträchtigsten für die Fischgesundheit sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht
Hier haben Sie Platz, einen für Sie wichtigen Bereich zu nennen, falls wir diesen vergessen haben: Am beeinträchtigsten/negativsten für.... sind...	1. _____ 2. _____ 3. _____	○ Weiss nicht

18) Welche Eingriffe des Menschen sind am förderlichsten bzw. schädlichsten für den Lebensraum Fliessgewässer?	
Förderlich:	Schädlich:
1._____	1._____
2._____	2._____
3._____	3._____

Thema: Bachforellenbestände

19) Veränderungen in der Natur, Umwelt oder am Gewässer können Auswirkungen auf verschiedene Bereiche haben.				
Wie würden Sie die Auswirkungen der Veränderung folgender **Einflüsse auf die Bestandsgrösse von Bachforellen** in Fliessgewässern beschreiben?	Vorteilhaft für die Bestands-grösse von Bachforellen	Nachteilig für die Bestands-grösse von Bachforellen	Spielt keine Rolle für die Bestands-grösse	Das weiss ich nicht
mehr Renaturierungsmassnahmen	○	○	○	○
mehr natürliche Feinde	○	○	○	○
mehr Naturverlaichung	○	○	○	○
Erhöhung der Strukturvielfalt	○	○	○	○
mehr Elterntiere im Fliessgewässer	○	○	○	○
Erhöhung des Grads der Naturnähe	○	○	○	○
mehr Eingriffe des Menschen an Gewässer	○	○	○	○
mehr Besatzmassnahmen	○	○	○	○
grösseres Interesse am Fischen	○	○	○	○
mehr Wasserkraftnutzung	○	○	○	○
strengere Schonbestimmungen	○	○	○	○
Förderung angestammter Bachforellenbestände	○	○	○	○
Erhöhung des Anteils chemischer Stoffe im Wasser	○	○	○	○
erhöhte Durchgängigkeit und Verbundenheit der Fliessgewässer	○	○	○	○
intensivere Bewirtschaftung	○	○	○	○
Verbesserung der Wasserqualität	○	○	○	○
Verbesserung der Fischgesundheit	○	○	○	○
Erhöhung des Nahrungsangebots	○	○	○	○
Verbesserung des Lebensraums	○	○	○	○
Erhöhung des Schlamm- und Feinsedimentanteils	○	○	○	○
Sonstiges:	○	○	○	○
Sonstiges:	○	○	○	○

20) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich bin der Meinung, dass in einem Fliessgewässer nur eine begrenzte Anzahl von Bachforellen leben kann.	○	○	○	○	○
Das Nahrungsangebot in Fliessgewässern ist in der Regel so gut, dass es für viel mehr Bachforellen reicht, als tatsächlich im Fluss leben.	○	○	○	○	○

21) Wie denken Sie, sollte ein Bachforellenbestand natürlicherweise zusammengesetzt sein?

- ○ Mehr jüngere als ältere Forellen
- ○ Mehr ältere als jüngere Forellen
- ○ Gleich viele jüngere und ältere Forellen
- ○ Das weiss ich nicht.

22) Welcher Prozess bestimmt nach Ihrer Erfahrung am massgeblichsten die Bestandsgrösse von Bachforellen nach dem Schlupf?

- ○ Wettbewerb/Konkurrenz mit gleichaltrigen Artgenossen.
- ○ Umweltfaktoren wie Hochwasser, Trockenheit, etc.
- ○ Zusammenspiel aus Wettbewerb und Umweltfaktoren.
- ○ Das weiss ich nicht.
- ○ Anderes, und zwar:

Thema: angestammte Bachforellenbestände

23) Was wirkt sich nach Ihrer Meinung am förderlichsten bzw. hinderlichsten auf die Erhaltung angestammter Bachforellenbestände aus?

Förderlich:	Hinderlich:
1._____	1._____
2._____	2._____
3._____	3._____

24)	sinnvoll	eher sinnvoll	eher nicht sinnvoll	nicht sinnvoll	Weiss nicht
Wie sinnvoll ist es nach Ihrer Meinung, dass Fische durch Besatzmassnahmen zwischen verschiedenen Flusssystemen ausgetauscht werden?	○	○	○	○	○

Thema: Natürliche Feinde

25) Bitte nennen Sie uns die – aus Ihrer Sicht – bedeutendsten Feinde von Bachforellen
1. _____ 2. _____ 3. _____

26) Was fördert bzw. hemmt eine Zunahme der Anzahl natürlicher Feinde von Bachforellen?	
Fördert:	Hemmt:
1._____	1._____
2._____	2._____
3._____	3._____

Thema: Naturverlaichung

27) Woran beurteilen Sie, ob in einem Fliessgewässer erfolgreiche, natürliche Fortpflanzung/Naturverlaichung bei Bachforellen stattfindet?
1. _____ 2. _____ 3. _____

28) Findet in dem von Ihnen hauptsächlich genutzten Gewässer erfolgreiche Naturverlaichung statt?	
○ Das weiss ich nicht.	
○ Nein	
○ Ja, diese ist für einen guten Bestand...	○ ausreichend. ○ nicht ausreichend. ○ Das weiss ich nicht.

29) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Unabhängig von der natürlichen Fortpflanzung sollte Bachforellenbesatz durchgeführt werden.	○	○	○	○	○

Thema: Bewirtschaftung

30) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Bewirtschaftung von Fliessgewässern und Besatzmassnahmen sind zwei Begriffe für ein und dieselbe Sache.	○	○	○	○	○
Besatzmassnahmen sind nur ein Gesichtspunkt unter vielen bei der Bewirtschaftung von Fliessgewässern.	○	○	○	○	○

31) Was wirkt sich nach Ihrer Meinung am förderlichsten bzw. hinderlichsten auf die Bewirtschaftung von Fliessgewässern aus?	
Förderlich: 1._____ 2._____ 3._____	Hinderlich: 1._____ 2._____ 3._____

32) Welche(s) Ziel(e) sollte Ihrer Meinung nach die Bewirtschaftung von Forellengewässern verfolgen:
(Mehrfachnennungen möglich)

- ☐ möglichst gesunder Forellenbestand
- ☐ möglichst grosser Forellenbestand
- ☐ möglichst attraktive Gestaltung des Fliessgewässers für Fischer
- ☐ Gewährleistung finanzieller Einnahmen für die Fischereiverwaltung
- ☐ Erhaltung angestammter Arten
- ☐ Erhöhung der Artenvielfalt
- ☐ Bewahrung der Tier & Pflanzenwelt
- ☐ Anderes Ziel: _____
- ☐ Weiss ich nicht

33) Welche Bewirtschaftungsmethoden halten Sie für am besten geeignet, um die Bestandsgrösse von Bachforellen zu verbessern?
Bitte bringen Sie die folgenden Bewirtschaftungsmethoden in die Reihenfolge, die für Sie am besten zutrifft. Bei „1." tragen Sie das Kürzel der Methode (z.B. „D" für Schongebiete) ein, die Sie für am besten geeignet halten und bei „7." die Methode, die Sie für am wenigsten geeignet halten. Jeder Zahl darf nur ein Kürzel zugeordnet werden.

1.____	**A** Besatz
2.____	**B** Schonmasse
3.____	**C** Schonzeit
4.____	**D** Schongebiete
5.____	**E** Fangzahlbeschränkung
6.____	**F** Beschränkung Anzahl Angeltage (oder Angler)
7.____	**G** Fischereiverbote

Thema: Besatzmassnahmen

34) Was wirkt sich nach Ihrer Meinung am förderlichsten bzw. hinderlichsten auf Besatzmassnahmen mit Bachforellen aus?	
Förderlich: 1._____ 2._____ 3._____	Hinderlich: 1._____ 2._____ 3._____

35) Finden in dem von Ihnen hauptsächlich genutzten Gewässer Besatzmassnahmen statt?

- ○ Das weiss ich nicht.
- ○ Nein
- ○ Ja

36) Wenn „ja", wie zufrieden sind Sie mit den Besatzmassnahmen?	sehr zufrieden	eher zufrieden	weder noch	eher un-zufrieden	sehr un-zufrieden
	○	○	○	○	○

37) Veränderungen in der Natur, Umwelt oder am Gewässer können Auswirkungen auf verschiedene Bereiche haben.				
Wie würden Sie die Auswirkungen der Veränderung folgender **Einflüsse für Besatzmassnahmen mit Bachforellen** in einem Fliessgewässer beschreiben? Durch...	...werden Besatzmass-nahmen eher notwendig	...werden Besatzmass-nahmen eher überflüssig	Spielt keine Rolle für Besatzmass-nahmen	Das weiss ich nicht
mehr Renaturierungsmassnahmen	○	○	○	○
mehr natürliche Feinde	○	○	○	○
mehr Naturverlaichung	○	○	○	○
Erhöhung der Strukturvielfalt	○	○	○	○
mehr Elterntiere im Fliessgewässer	○	○	○	○
Erhöhung des Grads der Naturnähe	○	○	○	○
mehr Eingriffe des Menschen an Gewässer	○	○	○	○
grössere Bachforellenbestände	○	○	○	○
grösseres Interesse am Fischen	○	○	○	○
mehr Wasserkraftnutzung	○	○	○	○
strengere Schonbestimmungen	○	○	○	○
Förderung angestammter Bachforellenbestände	○	○	○	○
Erhöhung des Anteils chemischer Stoffe im Wasser	○	○	○	○
erhöhte Durchgängigkeit und Verbundenheit der Fliessgewässer	○	○	○	○
intensivere Bewirtschaftung	○	○	○	○
Verbesserung der Wasserqualität	○	○	○	○
Verbesserung der Fischgesundheit	○	○	○	○
Erhöhung des Nahrungsangebots	○	○	○	○
Verbesserung des Lebensraums	○	○	○	○
Erhöhung des Schlamm- und Feinsedimentanteils	○	○	○	○
Sonstiges:	○	○	○	○
Sonstiges:	○	○	○	○

38) Viele Gründe sind für Besatzmassnahmen denkbar. Welches sind aus Ihrer Sicht die Hauptgründe, aus denen Besatz gemacht werden sollte? Und wie gut werden diese Ziele durch Besatz erreicht?

Bitte kreuzen Sie bei Frage 38a die Gründe an, aus denen Besatz gemacht werden sollten und bei 38b, wie gut diese Ziele erreicht werden.

38a) Besatzmassnahmen sollten gemacht werden, um... (Mehrfachnennungen möglich)		38b) Werden diese Ziele bisher durch Besatz erreicht?					
		voll und ganz	eher ja	teils-teils	eher nein	ganz und gar nicht	Weiss nicht
☐ mehr Fische für Fischer zu haben.	→	○	○	○	○	○	○
☐ hohe Entnahmemengen durch natürliche Feinde auszugleichen.	→	○	○	○	○	○	○
☐ Auswirkungen der Fischerei auszugleichen.	→	○	○	○	○	○	○
☐ einen Mangel bei der natürlichen Fortpflanzung auszugleichen.	→	○	○	○	○	○	○
☐ natürliche Schwankungen in der Bestandsgrösse auszugleichen.	→	○	○	○	○	○	○
☐ in allen Fliessgewässern Forellen fangen zu können.	→	○	○	○	○	○	○
☐ dem Grundsatz „Wer ernten will, muss säen“ zu folgen.	→	○	○	○	○	○	○
☐ aus anderem Grund, und zwar:	→	○	○	○	○	○	○

39) Nach welchem der folgenden Grundsätze sollte Ihrer Meinung nach Besatz geplant werden?

- ○ So wenig wie möglich.
- ○ So viel wie möglich.
- ○ Auf Besatz sollte verzichtet werden.
- ○ Weiss ich nicht

40) Wie sollte die Menge für Besatzmassnahmen in dem von Ihnen hauptsächlich genutzten Gewässer festgelegt werden?
(Mehrfachnennungen möglich)

- ☐ Die Menge ist und bleibt seit Jahren gleich.
- ☐ Das weiss ich nicht.
- ☐ abhängig von der Fangmenge der letzten Jahre.
- ☐ abhängig von der Verfügbarkeit von Besatzfischen.
- ☐ abhängig von der Vorgabe der Verwaltungen.
- ☐ abhängig vom Beschluss des Vereinsvorstands.
- ☐ Die Menge sollte von etwas anderem abhängig sein, und zwar von:

41) Sollte es nach Ihrer Meinung ein **langfristiges** Ziel von Bewirtschaftung sein, zukünftig auf Besatzmassnahmen verzichten zu können?

- ○ Ja
- ○ Nein
- ○ Das weiss ich nicht.

42) Fischbesatz kann nach meiner Einschätzung im schlimmsten Fall.... (Mehrfachnennungen möglich)
☐ nicht erfolgreich sein ☐ Konkurrenz/Wettbewerb innerhalb der Bachforellenbestände hervorrufen ☐ Konkurrenz/Wettbewerb zwischen Bachforellen und anderen Fischarten hervorrufen ☐ Krankheit verursachen/verbreiten ☐ Die Anzahl natürlicher Feinde erhöhen ☐ zu Kreuzungen zwischen Besatz- und Wildfischen führen ☐ Fischbesatz ist immer positiv. ☐ Weiss ich nicht

43) Was denken Sie? Wie viel Prozent der Fische, die Sie fangen, stammen aus Besatzmassnahmen?	ca. ___%

44)	voll und ganz	eher	teils-teils	eher nicht	Ganz und gar nicht
Entspricht dieser Anteil der Besatzfische an Ihrem Fang Ihren Erwartungen?	○	○	○	○	○

45) Dieser Anteil der Besatzfische an Ihrem Fang spricht dafür, dass die Besatzmassnahmen...
○ sehr erfolgreich waren. ○ eher erfolgreich waren. ○ eher nicht erfolgreich waren. ○ gar nicht erfolgreich waren. ○ Das weiss ich nicht. ○ Den Erfolg von Besatzmassnahmen beurteile ich nach anderen Gesichtspunkten, und zwar:

46) Ich war bereits persönlich an Besatzmassnahmen beteiligt.					
○ Nein ○ Ja. Diese waren meiner Einschätzung nach...	sehr erfolgreich	eher erfolgreich	eher nicht erfolgreich	gar nicht erfolgreich	Weiss nicht
	○	○	○	○	○

47) Ich bin der Meinung, man sollte Besatzmassnahmen mit...	stark erweitern	eher erweitern	nicht verändern	eher einschränken	stark einschränken	Weiss nicht
...fangreifen Forellen...	○	○	○	○	○	○
...Eiern und Brütlingen...	○	○	○	○	○	○
...Sömmerlingen...	○	○	○	○	○	○

48) Welches Alter ist nach Ihrer Einschätzung ideal für Besatzfische?

- ○ Besatzfische sollten so jung wie möglich sein.
- ○ Je älter Besatzfische sind, desto besser.
- ○ Am besten wäre es, wenn Besatzfische verschiedene Altersstufen haben.
- ○ Das Alter von Besatzfischen spielt keine Rolle.
- ○ Das weiss ich nicht.

49)	weniger als 10%	10% bis 30%	31% bis 60%	61% bis 90%	mehr als 90%	Weiss nicht
Wie viele der eingesetzten Sömmerlinge überleben Ihrer Einschätzung nach im Allgemeinen bis zur Fangreife?	○	○	○	○	○	○

50)	machbar	eher machbar	eher nicht machbar	gar nicht machbar	Weiss nicht
Mit Besatzmassnahmen aufzuhören und heutzutage trotzdem erfolgreich zu fischen, dass halte ich für...	○	○	○	○	○

51) Es gibt verschiedene Gründe und Ursachen, warum Forellenbestände abnehmen. Für welche der folgenden denkbaren Gründe ist der Besatz mit **Jungfischen** eine gute Massnahme?
(Mehrfachnennungen möglich)

- ☐ geringes Nahrungsangebot
- ☐ schlechte Wasserqualität
- ☐ Mangel an Laichplätzen oder unzureichende Laichplätze
- ☐ hohe Fischentnahme durch Fischer
- ☐ hohe Fischentnahme durch Fressfeinde
- ☐ geringer Fischbestand nach einem akuten Fischsterben
- ☐ hohe Chemikalienbelastung
- ☐ schlechte Lebensräume für Jungfische
- ☐ zunehmende Wassertemperaturen
- ☐ hohe Sterblichkeit infolge der Nierenkrankheit PKD
- ☐ Jungfischbesatz ist nie eine gute Massnahme
- ☐ sonstige Gründe, und zwar:

52) Welche Herkunft sollten Besatzfische idealerweise haben?

- ○ Jährliche Wildfänge von Elterntieren aus den Besatzgewässern.
- ○ Elterntiere sollten aus einer Zucht stammen, deren Fische auf Wildfänge aus dem Besatzgewässer zurückgehen.
- ○ Elterntiere sollten am besten aus einer langjährigen, auch überregionalen Fischzucht stammen, da diese am wenigsten Probleme bei der Haltung und Aufzucht bereiten.
- ○ Die Herkunft der Elterntiere spielt keine Rolle.
- ○ Das weiss ich nicht.
- ○ Sonstige Herkunft, und zwar:

53)	sehr positiv	eher positiv	weder noch	eher negativ	sehr negativ	Weiss nicht
Die Auswirkungen von Bachforellenbesatz, bei funktionierender Naturverlaichung, sind nach meiner Meinung für die natürliche Fortpflanzung...	○	○	○	○	○	○

54)	sehr gut	eher gut	weder gut noch schlecht	eher schlecht	sehr schlecht	Weiss nicht
Ich halte Fischbesatz als Bewirtschaftungs-massnahme in *naturnahen* Fliessgewässern für...	○	○	○	○	○	○
Ich halte Fischbesatz als Bewirtschaftungs-massnahme in *naturfernen* Fliessgewässern für...	○	○	○	○	○	○

55) Insgesamt finde ich Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gut	⊢——————————————————⊣	sehr schlecht	○

56) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Durch Jungfischbesatz wird der Bachforellenbestand künstlich erhöht, ohne Rücksicht darauf, wie viele Forellen natürlicherweise im Fluss leben.	○	○	○	○	○
Es sollte auch erlaubt sein, nicht-einheimische Fischarten einzusetzen.	○	○	○	○	○
Die Besatzmenge sollte davon abhängen, wie viel Lebensraum zur Verfügung steht.	○	○	○	○	○

57) Wie sehr wären Sie dazu bereit, künftig bei Besatzmassnahmen aktiv mitzuwirken? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht dazu bereit sind, an Besatzmassnahmen mitzuwirken. 100 heisst, dass Sie eine überaus hohe Bereitschaft haben.			Weiss nicht
0	⊢——————————————————⊣	100	○

Thema: Zufriedenheit und Bewertung

Als nächstes möchten wir gerne erfahren, wie zufrieden Sie mit verschiedenen Bereichen sind und wie Sie selber Ihren Kenntnisstand zu diesen Bereichen einschätzen.

58) Wie zufrieden sind Sie an dem von Ihnen hauptsächlich genutzten Gewässer mit...	sehr zufrieden	eher zufrieden	weder noch	eher un-zufrieden	sehr un-zufrieden	Weiss nicht
...dem Lebensraum „Fliessgewässer“?	○	○	○	○	○	○
...der Wasserqualität?	○	○	○	○	○	○
...dem Grad der Naturnähe?	○	○	○	○	○	○
...der Strukturvielfalt des Gewässers?	○	○	○	○	○	○
...den Eingriffen des Menschen?	○	○	○	○	○	○
...dem Nahrungsangebot für Bachforellen?	○	○	○	○	○	○
...dem Anteil chemischer Stoffe im Gewässer?	○	○	○	○	○	○
...der Bestandsgrösse von Bachforellen?	○	○	○	○	○	○
...der Naturverlaichung?	○	○	○	○	○	○
...der Fischgesundheit?	○	○	○	○	○	○
...der Bewirtschaftung?	○	○	○	○	○	○
...der Planung und Durchführung von Besatzmassnahmen?	○	○	○	○	○	○
...der Anzahl natürlichen Feinde von Bachforellen?	○	○	○	○	○	○
...der Erhaltung des angestammten Bachforellenbestandes?	○	○	○	○	○	○

59) Insgesamt bin ich mit dem Fischen in Schweizer Fliessgewässern derzeit... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr unzufrieden	⊢——————————⊣	sehr zufrieden	○

60)	absolut richtig	eher richtig	eher falsch	absolut falsch	Weiss nicht
Die Vorgaben und Vorschriften der Kantone in Bezug auf die Besatzmassnahmen bei Bachforellen halte ich für...	○	○	○	○	○

61) Fischen Sie ausschliesslich in Schweizer Gewässern oder fischen Sie ebenfalls im Ausland?

- ○ Nein, ich fische nur in der Schweiz.
- ○ Ja, ich fische auch im Ausland. Und zwar in folgendem/n Land/Ländern:

62) Wenn Sie auch im Ausland fischen, was ist aus Ihrer Sicht der Hauptunterschied zum Fischen in Schweizer Gewässern? Was bietet Ihnen das Fischen im Ausland, das Ihnen in Schweizer Gewässern fehlt?

63) Als wie hoch schätzen Sie Ihre Kenntnisse in folgenden Bereichen ein?	sehr hoch	eher hoch	weder hoch noch niedrig	eher niedrig	sehr niedrig
Lebensraum „Fliessgewässer“	○	○	○	○	○
Wasserqualität	○	○	○	○	○
Naturnähe von Fliessgewässern	○	○	○	○	○
Strukturvielfalt	○	○	○	○	○
Eingriffe des Menschen am Fliessgewässer	○	○	○	○	○
Nahrungsangebot für Bachforellen	○	○	○	○	○
Chemische Stoffe in Fliessgewässern	○	○	○	○	○
Bestandsgrösse von Bachforellen	○	○	○	○	○
Natürliche Fortpflanzung von Bachforellen	○	○	○	○	○
Bewirtschaftung	○	○	○	○	○
Planung & Durchführung von Besatzmassnahmen	○	○	○	○	○
Natürliche Feinde	○	○	○	○	○
Fischgesundheit	○	○	○	○	○
Erhaltung angestammter Bachforellenbestände	○	○	○	○	○

64) Insgesamt bezeichne ich meine Kenntnisse bei Themen rund um die Fischerei als... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr niedrig	⊢——————————⊣	sehr hoch	○

Teil 3: Allgemeine Fragen zu den Themen Natur, Vereine etc.

Den grössten Teil unserer Fragen haben Sie nun hinter sich! In dem folgenden Teil interessieren uns vor allem Ihre Einstellungen und Erfahrungen zu Themen, die nicht direkt mit dem Fischen zu tun haben, aber trotzdem für das Fischen eine grosse Rolle spielen.

65) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Wenn ich mit dem Fischen aufhöre, verliere ich wahrscheinlich den Kontakt zu vielen meiner Freunde.	○	○	○	○	○
Wenn ich nicht fischen gehen könnte, dann wüsste ich nicht, was ich sonst machen könnte.	○	○	○	○	○
Wegen der Fischerei habe ich keine Zeit, an anderen Freizeitaktivitäten teilzunehmen.	○	○	○	○	○
Die meisten meiner Freunde haben in irgendeiner Art und Weise mit Fischerei zu tun.	○	○	○	○	○
Ich halte mich selber für einen Experten in der Fischerei.	○	○	○	○	○
Ich finde, dass ein grosser Teil meines Lebens sich um das Fischen dreht.	○	○	○	○	○
Andere sagen wahrscheinlich, dass ich zu viel Zeit für das Fischen aufwende.	○	○	○	○	○
Ich gehe lieber fischen als irgendetwas anderes zu tun.	○	○	○	○	○
Andere Freizeitaktivitäten interessieren mich nicht so sehr wie das Fischen.	○	○	○	○	○

66) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Fische und andere Tiere haben die gleichen Rechte wie wir Menschen.	○	○	○	○	○
Gewässer sind isolierte Räume mit begrenztem Fischreichtum.	○	○	○	○	○
Um unsere Bedürfnisse zu befriedigen haben wir Fischer das Recht, die natürlichen Gewässer zu verändern.	○	○	○	○	○
Wenn wir Fischer in ein Gewässer eingreifen, hat das oft negative Konsequenzen zur Folge.	○	○	○	○	○
Das natürliche Gleichgewicht der Gewässer ist stark genug, die Eingriffe durch uns Fischer zu verkraften.	○	○	○	○	○
Wir Fischer nähern uns zahlenmässig der Grenze an, die die Gewässer verkraften können.	○	○	○	○	○
Wir Fischer beeinflussen die Gewässer weniger als andere Gewässernutzer.	○	○	○	○	○
Die Diskussion um den Rückgang von Bachforellenfängen in der Schweiz wird stark übertrieben.	○	○	○	○	○
Wenn wir Fischer so weitermachen wie bisher, werden wir bald eine ökologische Notlage in den Gewässern erleben.	○	○	○	○	○
Wir Fischer sind sehr gut dafür geeignet, die Gewässer zu bewirtschaften und zu schützen.	○	○	○	○	○
Unsere Lernfähigkeit und unsere Beobachtungsgabe als Fischer werden bewirken, dass wir die Gewässer nicht vollständig überfischen.	○	○	○	○	○
Es ist immer noch so, dass wir Fischer viel zu wenig für den Gewässerschutz tun.	○	○	○	○	○
Zugunsten des Gewässerschutzes sollten wir Fischer bereit sein, unsere derzeitigen Fischereiverhaltensweisen zu verändern.	○	○	○	○	○
Durch die Angelfischerei können Bachforellenbestände so weit verringert werden, dass sie sich von alleine nicht wieder erholen.	○	○	○	○	○

67) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Wenn ich fischen gehe, dann bin ich nicht zufrieden, bis ich nicht irgendetwas gefangen habe.	○	○	○	○	○
Ein Tag an dem ich fischen gehe, kann für mich erfolgreich sein, auch wenn ich keinen Fisch fange.	○	○	○	○	○
Ich bin genau so glücklich, wenn ich fischen gehe und keinen Fisch fange.	○	○	○	○	○
Ich ziehe den Fang von Wildfischen dem Fang von Fischen aus Besatzmassnahmen vor.	○	○	○	○	○
Wenn ich Wildfische fange, dann bin ich auch mit einem geringeren Tagesfang zufrieden.	○	○	○	○	○

68) Sind Sie Mitglied in einem Fischereiverein oder Club?			
○ Nein (-> Weiter bei ✭, Seite 19, Frage 74)			
○ Ja			
69) Wie viele Mitglieder hat der Verein, in dem Sie Mitglied sind?			
○ bis zu 20	○ 21 – 40	○ 41 – 60	○ mehr als 60

70) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen zu Besatzmassnahmen aus meinem Verein für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Ich äussere meine Meinung zu Besatzmassnahmen, egal was die anderen Vereinsmitglieder denken.	○	○	○	○	○
Im Verein sind es immer die gleichen Leute, die bei Besatzfragen den Ton angeben.	○	○	○	○	○
Der Aufwand, den mein Verein für Besatzmassnahmen betreibt, steht in einem guten Verhältnis zum Ertrag.	○	○	○	○	○
In meinem Verein habe ich die Möglichkeit, mich aktiv an der Besatzplanung zu beteiligen.	○	○	○	○	○

71)	immer	oft	manchmal	selten	nie
Wie oft wird bei Vereinstreffen über Themen, die mit Fischbesatz zu tun haben, gesprochen?	○	○	○	○	○

72)	wichtig	eher wichtig	eher un-wichtig	un-wichtig
Zum Verein dazuzugehören ist mir...	○	○	○	○

73) Der Einfluss meines Vereins auf meine Meinung zu Fischbesatz und Bewirtschaftung ist... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gering	├──┤	sehr hoch	○

★

74) Von wem haben Sie **am meisten** über das Fischen gelernt?
○ Ich habe mir das Fischen selber beigebracht. ○ Im Verein habe ich am meisten über das Fischen gelernt. ○ Verwandte/Familienangehörige haben mir am meisten über das Fischen beigebracht. ○ Ich habe das meiste über das Fischen von anderen gelernt, und zwar von:

75) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Das Thema Fischbesatz und Bewirtschaftung diskutiere ich auch mit Personen aus meiner Familie.	○	○	○	○	○
Ich halte Wissen und Erfahrungen rund um die Fischerei Personen aus meiner Familie für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○

76) Der Einfluss von Personen aus meiner Familie auf meine Meinung zu Fischbesatz und Bewirtschaftung ist... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr niedrig	⊢———	sehr hoch	○

77) Welche Fischarten fangen Sie am häufigsten?
1. _____ 2. _____ 3. _____

78) Wie stark beabsichtigen Sie, künftig an Besatzmassnahmen teilzunehmen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht beabsichtigen, teilzunehmen. 100 heisst, dass Sie sehr stark beabsichtigen, an Besatzmassnahmen teilzunehmen			Weiss nicht
0	⊢———	100	○

79) An welchen der folgenden Aktivitäten rund um die Fischerei sind Sie aktiv wie häufig beteiligt?	immer	oft	manchmal	selten	nie	Gibt es bei uns nicht
Abfischungen	○	○	○	○	○	○
elektrische Kontrollabfischung	○	○	○	○	○	○
Bachputzete	○	○	○	○	○	○
Besatzfischzucht	○	○	○	○	○	○
Fischbesatz	○	○	○	○	○	○
Jungfischerausbildung	○	○	○	○	○	○
Laichfischfang	○	○	○	○	○	○
Mithilfe bei Vereinsanlässen	○	○	○	○	○	○
Renaturierungsmassnahmen	○	○	○	○	○	○
Arbeit im Vereinsvorstand	○	○	○	○	○	○
Sonstiges, und zwar:	○	○	○	○	○	○

80) Wenn Sie sich über wichtige Themen für das Fischen informieren... welche Quellen nutzen Sie?
(Mehrfachnennungen möglich)

- ☐ Fachzeitschriften
- ☐ Vereinszeitung
- ☐ Fernsehen
- ☐ Seminare & Workshops
- ☐ andere Vereinsmitglieder
- ☐ Freundeskreis
- ☐ Behörden
- ☐ andere Quellen, und zwar:
- ☐ Presse
- ☐ andere (befreundete) Fischer
- ☐ Informationsveranstaltungen des Vereins
- ☐ Internet
- ☐ Informationsveranstaltungen ausserhalb des Vereins
- ☐ Familie
- ☐ FIBER

Teil 4: Ihre Anregungen, Fragen und Rückmeldungen zu dieser Befragung

81) Wie sind Sie auf diese Umfrage aufmerksam geworden?

- ○ Ich habe den Fragebogen per Post erhalten.
- ○ Ich habe den Fragebogen im Internet unter www.fischer.eawag.ch bestellt bzw. selber ausgedruckt.
- ○ Ich habe den Fragebogen von meinem Verein erhalten.
- ○ Ich habe den Fragebogen von einem Freund oder Bekannten bekommen.
- ○ Der Fragebogen lag in einem Geschäft aus.
- ○ Ich habe den Fragebogen auf einem anderen Weg bekommen, und zwar:

82) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Bei der Bearbeitung dieses Fragebogens musste ich öfter lange nachdenken.	○	○	○	○	○

83) In diesem Fragebogen wurden – aus meiner Sicht – alle wichtigen Themen rund um Fische, Fliessgewässer und Bewirtschaftung behandelt.

- ○ Ja
- ○ Nein, es fehlte:

84) Gab es in diesem Fragebogen Themen, über die Sie vorher noch nie nachgedacht haben?
(Mehrfachnennungen möglich)

○ Nein
○ Ja, und zwar über:

☐ Lebensraum „Fliessgewässer“	☐ Bewirtschaftung	☐ Naturnähe
☐ chemische Stoffe	☐ Wasserqualität	☐ Beschaffenheit der Gewässer
☐ Eingriffe durch den Menschen	☐ Bestandsgrösse	☐ Besatzmassnahmen
☐ Fischgesundheit	☐ Nahrungsangebot	☐ Fortpflanzung/Naturverlaichung
☐ Erhaltung angestammter Forellenarten	☐ natürliche Feinde	☐ Anderes Thema:_____

85) Wenn Sie jetzt einmal an diesen Fragebogen denken, in welchem Ausmass konnten Sie Ihre Erfahrungen und Ihre Kenntnisse als Fischer einbringen?
Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht.

gar nicht ├──┤ vollständig

86) Gibt es noch etwas, das Sie uns gerne mitteilen möchten? Fragen, Anregungen und Kritik sind herzlich willkommen!

Herzlichen Dank, dass Sie sich die Zeit genommen haben!
Ihre Angaben sind sehr wichtig für uns und Sie haben uns damit sehr unterstützt!

Wünschen Sie eine Rückmeldung zu Ihren Antworten?

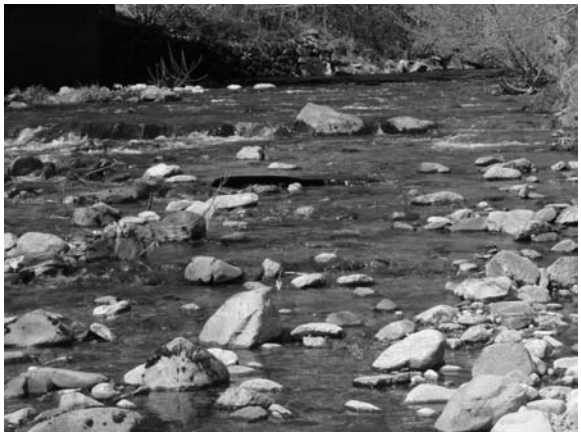
○ Ich möchte **keine Rückmeldung** zu meinen Angaben erhalten.
○ Ich möchte eine Rückmeldung zu meinen Angaben erhalten.

Achtung:
Füllen Sie bitte den folgenden Abschnitt nur dann aus, wenn Sie eine Rückmeldung zu Ihren Angaben erhalten möchten! Wir werden Ihre Angaben ausschliesslich für die Rückmeldung an Sie verwenden. **Eine Weitergabe Ihrer persönlichen Daten an Dritte findet selbstverständlich nicht statt.**

Name, Vorname:

Adresse:
Plz, Ort:

87) Eine allerletzte Frage haben wir noch an Sie: Dürfen wir Ihnen für eine eventuelle Folgebefragung für dieselbe Studie erneut einen Fragebogen zusenden?
○ Ja ○ Nein



XIV.3 Supplementary material used in stage III

XIV.3.1 Baseline questionnaire (Stage III.1)

Liebe Fischerin, lieber Fischer,

vielen Dank für Ihr Interesse an unserer Umfrage! In dem vor Ihnen liegenden Fragebogen haben wir verschiedene Fragen rund um das Fischen zusammengestellt.

Insgesamt besteht der Fragebogen aus 4 Teilen:

1. Angaben zu Ihrer Person
   (Die Angaben zu Ihrer Person benötigen wir aus rein statistischen Gründen.)
2. Fragen zu Ihren Erfahrungen beim und Vorstellungen zum Fischen, Fischbeständen und deren Bewirtschaftung
3. Allgemeine Fragen zu den Themen Natur, Vereine etc.
4. Ihre Anregungen, Fragen und Rückmeldungen zu dieser Befragung

Was erwartet Sie in diesem Fragebogen?

- Bei sehr vielen Fragen können Sie einfach ankreuzen, was am ehesten Ihrer Meinung entspricht. Wenn „Mehrfachnennungen möglich“ zusätzlich bei der Frage steht, können Sie mehrere zutreffende Antworten auswählen.
- Wenn Sie eine Frage ohne Antwortvorgaben beantworten, reichen uns Stichworte aus.
- Bei einigen Fragen finden Sie die Antwortmöglichkeit „Weiss nicht“. Hier bitten wir Sie, diese Antwort nur zu wählen, wenn Sie wirklich keinerlei Vorstellung oder Idee zur Beantwortung der Frage haben.

Warum ist dieser Fragebogen so lang?

Bisher gibt es kaum Studien, die die umfangreichen Erfahrungen und das Wissen von Fischern mit wissenschaftlichen Ergebnissen und Theorien in Verbindung bringen.
Genau dies haben wir uns aber mit dieser Befragung vorgenommen!
Daher würden Sie uns sehr helfen, wenn Sie uns bei dieser „Pionierarbeit“ unterstützen und sich nicht von der Länge des Fragebogens (Bearbeitungsdauer ca. 60 Min.) abschrecken lassen. Als kleines „Dankeschön“ für Ihre Mühen möchten wir Ihnen gerne eine Rückmeldung Ihrer Angaben zukommen lassen, aus der Sie ersehen können, welcher „Anglertyp“ Sie sind. Füllen Sie dazu einfach den beiliegenden Zettel aus und legen Sie diesen zusammen mit dem Fragebogen in das Antwortkuvert. Wir nutzen die Angaben nur für die Rückmeldung, die Auswertung erfolgt selbstverständlich vollständig anonymisiert!

Eine Bitte haben wir noch an Sie:

- Beantworten Sie den Fragenbogen bitte vollständig und so, wie es Ihnen spontan in den Sinn kommt. Nicht ganz ausgefüllte Fragebögen sind für uns nur sehr schwer auszuwerten.

Was passiert mit den Ergebnissen?

Wir werden die Fragebögen per Computer erfassen und auswerten, um ein Gesamtbild der Schweizer Fischerinnen und Fischer hinsichtlich ihrer Erfahrungen und Meinungen zu Themen rund um das Fischen, Fischbestände und deren Bewirtschaftung zu erhalten. Besonders interessiert uns, durch welche Erfahrungen Fischerinnen und Fischer – als Expertinnen und Experten – Vorstellungen und Wissen über das Fischen aufbauen. Die ersten Ergebnisse dieser Studie können Sie ab Dezember 2008 im Internet unter http://www.fischer.eawag.ch finden oder treten Sie einfach mit uns in Kontakt, dann senden wir Ihnen die Ergebnisse auch gerne schriftlich zu.

Bereits jetzt möchten wir uns für Ihre Teilnahme an dieser Befragung herzlich bedanken!

gez.
Eike von Lindern Susanne Haertel-Borer

Teil 1: Statistische Angaben

In diesem ersten Teil möchten wir etwas über Sie erfahren. Ihre Angaben benötigen wir für rein statistische Zwecke.

1) In welchem Jahr sind Sie *geboren*? [ ]

2) Vor wie vielen Jahren haben Sie mit dem *Fischen* begonnen? [ ]

3) Welchen höchsten Ausbildungsabschluss haben Sie?

○ keinen
○ obligatorische Schule
○ Berufslehre, Berufsschule, Berufsmaturität
○ Maturitätsschule, Lehrerseminar oder vergleichbar
○ höhere Berufsausbildung (Meisterdiplom, eidg. Fachausweis, HTL, Fachhochschule etc.)
○ Universität, Hochschule
○ Ich habe einen anderen Abschluss, und zwar: _____

4) Welchen Beruf üben Sie **zurzeit** aus? (Mehrfachnennungen möglich)

☐ Schüler/in	☐ Militärdienst	☐ Arbeiter/in
☐ Student/in	☐ Zivildienst	☐ Facharbeiter/in
☐ Auszubildende/r	☐ Renter/in, Pensionär/in	☐ momentan ohne Arbeit
☐ Hausfrau/mann	☐ Angestellte/r	☐ Sonstiger Beruf,
☐ Selbstständige/r	☐ leitd. Angestellte/r	und zwar:

5) Mein Berufsfeld ist eher...

○ technisch-handwerklich ○ wissenschaftlich ○ künstlerisch ○ pflegerisch
○ pädagogisch ○ kaufmännisch ○ sonstiges:_____

6) In meinem Haushalt wohnen ausser mir [ ]Personen. Davon sind ausser mir [ ] Personen Fischer.

7) Welches ist die Sprache, in der Sie denken und die Sie am besten beherrschen?

○ deutsch ○ französisch ○ italienisch ○ rätoromanisch
○ andere, und zwar: _____

8) In welcher Gegend wohnen Sie?

○ auf dem Land
○ Vorstadt/Stadtrand oder Kleinstadt
○ Stadt

9) Ich bin...

○ weiblich
○ männlich

10) In welchem bzw. welchen Kantonen fischen Sie regelmässig? (Mehrfachnennungen möglich)

☐ AG	☐ GE	☐ OW	☐ UR
☐ AR	☐ GL	☐ SG	☐ VD
☐ AI	☐ GR	☐ SH	☐ VS
☐ BL	☐ JU	☐ SO	☐ ZG
☐ BS	☐ LU	☐ SZ	☐ ZH
☐ BE	☐ NE	☐ TG	
☐ FR	☐ NW	☐ TI	

11) Ich nutze *hauptsächlich*...

○ Pachtgewässer ○ Privatgewässer
○ Patentgewässer ○ Gewässer mit Freiangelrecht

12) Wie häufig fischen Sie an folgenden Gewässern?	immer	oft	manchmal	selten	nie
Bäche & kleine Flüsse	○	○	○	○	○
Flüsse	○	○	○	○	○
grosse Seen	○	○	○	○	○
Weiher & kleine Seen	○	○	○	○	○
Andere Gewässer:_____	○	○	○	○	○

13) Wie viele Gewässer befischen Sie regelmässig?	[ ]
14) An wie vielen Tagen gehen Sie im Jahr durchschnittlich fischen?	[ ]

15) Welche der folgenden Angeltechniken wenden Sie an? (Mehrfachnennungen möglich)
☐ Fliegenfischerei ☐ Spinnfischerei ☐ Fischerei mit Naturködern ☐ anderes, und zwar:_____

Teil 2: Ihre Erfahrungen mit dem Fischen, Fischbeständen und deren Bewirtschaftung

Der zweite Teil dieser Befragung ist am umfangreichsten. Damit Ihnen die Beantwortung so einfach wie möglich ist, haben wir die folgenden Fragen in verschiedene Themen unterteilt

Thema: Lebensraum

16) Was bedeutet „Lebensraum“ in Zusammenhang mit Fliessgewässern für Sie? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.	
17) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf den Lebensraum „Fliessgewässer“ aus?	
Positiv:	Negativ:

Thema: Wasserqualität

18) Wenn Sie den Begriff „Wasserqualität“ hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

19) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf die Wasserqualität eines Fliessgewässers aus?	
Positiv:	Negativ:

Thema: Naturnähe

20) Was bedeutet der Begriff „Naturnähe“ in Zusammenhang mit Fliessgewässern für Sie? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

21) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf den Grad der Naturnähe von Fliessgewässern aus?	
Positiv:	Negativ:

Thema: Strukturvielfalt

22) Wenn Sie „Strukturvielfalt“ hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

23) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf die Strukturvielfalt eines Fliessgewässers aus?	
Positiv:	Negativ:

Thema: Eingriffe des Menschen

24) An was denken Sie bei „Eingriffen des Menschen“? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

Thema: Nahrungsangebot

25) Wenn Sie den Begriff „Nahrungsangebot für Bachforellen“ hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

26) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf das Nahrungsangebot für Bachforellen aus?	
Positiv:	Negativ:

27) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Das Nahrungsangebot in Fliessgewässern ist in der Regel so gut, dass es für viel mehr Bachforellen reicht, als tatsächlich im Fluss leben.	○	○	○	○	○

Thema: Chemische Stoffe

28) Woran denken Sie, wenn Sie „Chemische Stoffe“ im Zusammenhang mit Fliessgewässern hören? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

29) Was erhöht bzw. verringert den Anteil chemischer Stoffe in Fliessgewässern?	
Erhöht:	Verringert:

Thema: Bachforellenbestände

30) Wenn Sie den Begriff „Bachforellenbestand“ in Zusammenhang mit Fliessgewässern hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

31) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich bin der Meinung, dass in einem Fliessgewässer nur eine begrenzte Anzahl von Bachforellen leben kann.	○	○	○	○	○

32) Wie denken Sie, sollte ein Bachforellenbestand natürlicherweise zusammengesetzt sein?
○ Mehr jüngere als ältere Forellen ○ Mehr ältere als jüngere Forellen ○ Gleich viele jüngere und ältere Forellen ○ Das weiss ich nicht.

33) Welcher Prozess bestimmt nach Ihrer Erfahrung am massgeblichsten die Bestandsgrösse von Bachforellen nach dem Schlupf?
○ Wettbewerb/Konkurrenz mit gleichaltrigen Artgenossen. ○ Umweltfaktoren wie Hochwasser, Trockenheit, etc. ○ Zusammenspiel aus Wettbewerb und Umweltfaktoren. ○ Das weiss ich nicht. ○ Anderes, und zwar:

34) Wie würden Sie die Folgen der Veränderung folgender **Einflüsse auf die Bestandsgrösse von Bachforellen** in Fliessgewässern beschreiben?	Das weiss ich nicht	Vorteilhaft für die Bestands-grösse von Bachforellen	Nachteilig für die Bestands-grösse von Bachforellen	Spielt keine Rolle für die Bestands-grösse
mehr Renaturierungsmassnahmen	○	○	○	○
mehr natürliche Feinde	○	○	○	○
mehr Naturverlaichung	○	○	○	○
Erhöhung der Strukturvielfalt	○	○	○	○
mehr Elterntiere	○	○	○	○
Erhöhung des Grads der Naturnähe	○	○	○	○
mehr Eingriffe des Menschen an Gewässer	○	○	○	○
mehr Besatzmassnahmen	○	○	○	○
grösseres Interesse am Fischen	○	○	○	○
mehr Wasserkraftnutzung	○	○	○	○
strengere Schonbestimmungen	○	○	○	○
Förderung angestammter Bachforellenbestände	○	○	○	○
Erhöhung des Anteils chemischer Stoffe im Wasser	○	○	○	○
erhöhte Durchgängigkeit und Verbundenheit der Fliessgewässer	○	○	○	○
intensivere Bewirtschaftung	○	○	○	○
Verbesserung der Wasserqualität	○	○	○	○
Verbesserung der Fischgesundheit	○	○	○	○
Erhöhung des Nahrungsangebots	○	○	○	○
Verbesserung des Lebensraums	○	○	○	○
Erhöhung des Schlamm- und Feinsedimentanteils	○	○	○	○
Sonstiges:	○	○	○	○
Sonstiges:	○	○	○	○

Thema: Naturverlaichung

35) Bei „Natürliche Fortpflanzung/Naturverlaichung von Bachforellen“ denke ich an: Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

36) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf die natürliche Fortpflanzung von Bachforellen aus?	
Positiv:	Negativ:

37) Woran beurteilen Sie, ob in einem Fliessgewässer erfolgreiche, natürliche Fortpflanzung/Naturverlaichung bei Bachforellen stattfindet?

38) Findet in dem von Ihnen hauptsächlich genutzten Gewässer erfolgreiche Naturverlaichung statt?
○ Ja ○ Nein ○ Das weiss ich nicht.
39) Wenn „ja“, ist diese dann ausreichend für einen guten Bestand?
○ Ja ○ Nein ○ Das weiss ich nicht.

40) In wie weit stimmen Sie folgender Aussager zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Unabhängig von der natürlichen Fortpflanzung sollte Bachforellenbesatz durchgeführt werden.	○	○	○	○	○

Thema: Fischgesundheit

41) Wenn Sie „Fischgesundheit“ hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

42) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf die Fischgesundheit aus?	
Positiv:	Negativ:

Thema: Bewirtschaftung

43) Wenn Sie „Bewirtschaftung“ in Zusammenhang mit Fliessgewässern hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

44) Was wirkt sich nach Ihrer Meinung am förderlichsten bzw. hinderlichsten auf die Bewirtschaftung von Fliessgewässern aus?	
Förderlich:	Hinderlich:

45) Welche(s) Ziel(e) sollte Ihrer Meinung nach die Bewirtschaftung von Forellengewässern verfolgen: (Mehrfachnennungen möglich)
☐ möglichst gesunder Forellenbestand ☐ möglichst grosser Forellenbestand ☐ möglichst attraktive Gestaltung des Fliessgewässers für Fischer ☐ Gewährleistung finanzieller Einnahmen für die Fischereiverwaltung ☐ Erhaltung angestammter Arten ☐ Erhöhung der Artenvielfalt ☐ Bewahrung der Tier & Pflanzenwelt ☐ Anderes Ziel: _____ ☐ Weiss ich nicht

46) Welche Bewirtschaftungsmethoden wirken sich aus Ihrer Sicht am stärksten auf die Bestandsgrösse von Bachforellen aus? Bitte bringen Sie die folgenden Bewirtschaftungsmethoden in die Reihenfolge, die für Sie am besten zutrifft. Bei „1.“ tragen Sie das Kürzel der Methode (z.B. „D“ für Schongebiete) ein, die Sie für am besten geeignet halten und bei „7.“ die Methode, die Sie für am wenigsten geeignet halten. Jeder Zahl darf nur ein Kürzel zugeordnet werden.	
1.____	**A** Besatz
2.____	**B** Schonmasse
3.____	**C** Schonzeit
4.____	**D** Schongebiete
5.____	**E** Fangzahlbeschränkung
6.____	**F** Beschränkung Anzahl Angeltage (oder Angler)
7.____	**G** Fischereiverbote

47) Wie würden Sie die Folgen der Veränderung folgender **Einflüsse für Besatzmassnahmen** in einem Fliessgewässer beschreiben? Durch...	Das weiss ich nicht	...werden Besatzmass-nahmen eher notwendig	...kann auf Besatzmass-nahmen eher verzichtet werden	Spielt keine Rolle für Besatzmass-nahmen
mehr Renaturierungsmassnahmen	○	○	○	○
mehr natürliche Feinde	○	○	○	○
mehr Naturverlaichung	○	○	○	○
Erhöhung der Strukturvielfalt	○	○	○	○
mehr Elterntiere	○	○	○	○
Erhöhung des Grads der Naturnähe	○	○	○	○
mehr Eingriffe des Menschen an Gewässer	○	○	○	○
grössere Bachforellenbestände	○	○	○	○
grösseres Interesse am Fischen	○	○	○	○
mehr Wasserkraftnutzung	○	○	○	○
strengere Schonbestimmungen	○	○	○	○
Förderung angestammter Bachforellenbestände	○	○	○	○
Erhöhung des Anteils chemischer Stoffe im Wasser	○	○	○	○
erhöhte Durchgängigkeit und Verbundenheit der Fliessgewässer	○	○	○	○
intensivere Bewirtschaftung	○	○	○	○
Verbesserung der Wasserqualität	○	○	○	○
Verbesserung der Fischgesundheit	○	○	○	○
Erhöhung des Nahrungsangebots	○	○	○	○
Verbesserung des Lebensraums	○	○	○	○
Erhöhung des Schlamm- und Feinsedimentanteils	○	○	○	○
Sonstiges:	○	○	○	○
Sonstiges:	○	○	○	○

48) Viele Gründe sind für Besatzmassnahmen denkbar. Welches sind aus Ihrer Sicht die Hauptgründe, aus denen Besatz gemacht werden sollte? Und wie gut werden diese Ziele durch Besatz erreicht?

Bitte kreuzen Sie bei Frage 48a die Gründe an, aus denen Besatz gemacht werden sollten und bei 48b, wie gut diese Ziele erreicht werden.

48a) Besatzmassnahmen sollten gemacht werden, um... (Mehrfachnennungen möglich)		48b) Werden diese Ziele bisher durch Besatz erreicht?					
		voll und ganz	eher ja	teils-teils	eher nein	ganz und gar nicht	Weiss nicht
☐ mehr Fische für Fischer zu haben.	→	○	○	○	○	○	○
☐ hohe Entnahmemengen durch natürliche Feinde auszugleichen.	→	○	○	○	○	○	○
☐ Auswirkungen der Fischerei auszugleichen.	→	○	○	○	○	○	○
☐ einen Mangel bei der natürlichen Fortpflanzung auszugleichen.	→	○	○	○	○	○	○
☐ natürliche Schwankungen in der Bestandsgrösse auszugleichen.	→	○	○	○	○	○	○
☐ in allen Fliessgewässern Forellen fangen zu können.	→	○	○	○	○	○	○
☐ dem Grundsatz „Wer ernten will, muss säen“ zu folgen.	→	○	○	○	○	○	○
☐ aus anderem Grund, und zwar:	→	○	○	○	○	○	○

49) Finden in dem von Ihnen hauptsächlich genutzten Gewässer Besatzmassnahmen statt?

- ○ Das weiss ich nicht. (Weiter bei ✯, Frage 52)
- ○ Nein (Weiter bei ✯, Frage 52)
- ○ Ja

50) Wenn „ja“, wie zufrieden sind Sie mit den Besatzmassnahmen?	sehr zufrieden	eher zufrieden	weder noch	eher un-zufrieden	sehr un-zufrieden
	○	○	○	○	○

51) Wie wird die Menge für Besatzmassnahmen in dem von Ihnen hauptsächlich genutzten Gewässer festgelegt? Die Menge ist...
(Mehrfachnennungen möglich)

- ☐ seit Jahren gleich.
- ☐ Das weiss ich nicht.
- ☐ abhängig von der Fangmenge der letzten Jahre.
- ☐ abhängig von der Verfügbarkeit von Besatzfischen.
- ☐ abhängig von der Vorgabe der Verwaltungen.
- ☐ abhängig vom Beschluss des Vereinsvorstands.
- ☐ von etwas anderem abhängig, und zwar von:

✯

52) Nach welchem der folgenden Grundsätze sollte Ihrer Meinung nach Besatz geplant werden?

- ○ So wenig wie möglich.
- ○ So viel wie möglich.
- ○ Auf Besatz sollte nach Möglichkeit verzichtet werden.
- ○ Weiss ich nicht

53) Sollte es nach Ihrer Meinung ein langfristiges Ziel von Bewirtschaftung sein, zukünftig auf Besatzmassnahmen verzichten zu können?
○ Ja ○ Nein ○ Das weiss ich nicht.

54) Fischbesatz kann nach meiner Einschätzung im schlimmsten Fall.... (Mehrfachnennungen möglich)
☐ nicht erfolgreich sein ☐ Konkurrenz/Wettbewerb innerhalb der Bachforellenbestände hervorrufen ☐ Konkurrenz/Wettbewerb zwischen Bachforellen und anderen Fischarten hervorrufen ☐ Krankheit verursachen/verbreiten ☐ Die Anzahl natürlicher Feinde erhöhen ☐ zu Kreuzungen zwischen Besatz- und Wildfischen führen ☐ Fischbesatz ist immer positiv. ☐ Weiss ich nicht

55) Was denken Sie? Wie viel Prozent der Fische, die Sie fangen, stammen aus Besatzmassnahmen?	ca. ___%

56) Ich war bereits persönlich an Besatzmassnahmen beteiligt.
○ Nein ○ Ja. Diese waren meiner Einschätzung nach...

sehr erfolgreich	eher erfolgreich	teils-teils	eher nicht erfolgreich	nicht erfolgreich	Weiss nicht
○	○	○	○	○	○

57) Ich bin der Meinung, man sollte Besatzmassnahmen mit...	stark erweitern	eher erweitern	nicht verändern	eher einschränken	stark einschränken	Weiss nicht
...fangreifen Forellen...	○	○	○	○	○	○
...Eiern und Brütlingen...	○	○	○	○	○	○
...Sömmerlingen...	○	○	○	○	○	○

58) Welches Alter ist nach Ihrer Einschätzung ideal für Besatzfische?
○ Besatzfische sollten so jung wie möglich sein. ○ Je älter Besatzfische sind, desto besser. ○ Am besten wäre es, wenn Besatzfische verschiedene Altersstufen haben. ○ Das Alter von Besatzfischen spielt keine Rolle. ○ Das weiss ich nicht.

59)	weniger als 10%	10% bis 30%	31% bis 60%	61% bis 90%	mehr als 90%	Weiss nicht
Wie viele der eingesetzten Sömmerlinge überleben Ihrer Einschätzung nach im Allgemeinen bis zur Fangreife?	○	○	○	○	○	○

60) Es gibt verschiedene Gründe und Ursachen, warum Forellenbestände abnehmen. Für welche der folgenden denkbaren Gründe ist der Besatz mit Jungfischen eine gute Massnahme?
(Mehrfachnennungen möglich)

- ☐ geringes Nahrungsangebot.
- ☐ schlechte Wasserqualität.
- ☐ Mangel an Laichplätzen oder unzureichende Laichplätze
- ☐ hohe Fischentnahme durch Fischer.
- ☐ hohe Fischentnahme durch Fressfeinde.
- ☐ geringer Fischbestand nach einem akuten Fischsterben.
- ☐ hohe Chemikalienbelastung
- ☐ schlechte Lebensräume für Jungfische
- ☐ zunehmende Wassertemperaturen
- ☐ hohe Sterblichkeit infolge der Nierenkrankheit PKD
- ☐ Jungfischesatz ist nie eine gute Massnahme.
- ☐ sonstige Gründe, und zwar:

61) Welche Herkunft sollten Besatzfische idealerweise haben?

- ○ Jährliche Wildfänge von Elterntieren aus den Besatzgewässern.
- ○ Elterntiere sollten aus einer Zucht stammen, deren Fische auf Wildfänge aus dem Besatzgewässer zurückgehen.
- ○ Elterntiere sollten am besten aus einer langjährigen, auch überregionalen Fischzucht stammen, da diese am wenigsten Probleme bei der Haltung und Aufzucht bereiten.
- ○ Die Herkunft der Elterntiere spielt keine Rolle.
- ○ Das weiss ich nicht.
- ○ Sonstige Herkunft, und zwar:

62)	machbar	eher machbar	eher nicht machbar	gar nicht machbar	Weiss nicht
Mit Besatzmassnahmen aufzuhören und heutzutage trotzdem erfolgreich zu fischen, dass halte ich für...	○	○	○	○	○

63)	sehr positiv	eher positiv	weder noch	eher negativ	sehr negativ	Weiss nicht
Die Auswirkungen von Bachforellenbesatz, bei funktionierender Naturverlaichung, sind nach meiner Meinung für die natürliche Fortpflanzung...	○	○	○	○	○	○

64)	sehr gut	eher gut	weder gut noch schlecht	eher schlecht	sehr schlecht	Weiss nicht
Ich halte Fischbesatz als Bewirtschaftungs-massnahme in *naturnahen* Fliessgewässern für...	○	○	○	○	○	○
Ich halte Fischbesatz als Bewirtschaftungs-massnahme in *naturfernen* Fliessgewässern für...	○	○	○	○	○	○

65) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Durch Jungfischbesatz wird der Bachforellenbestand künstlich erhöht, ohne Rücksicht darauf, wie viele Forellen natürlicherweise im Fluss leben.	○	○	○	○	○
Es sollte auch erlaubt sein, nicht-einheimische Fischarten einzusetzen.	○	○	○	○	○
Die Besatzmenge sollte davon abhängen, wie viel Lebensraum zur Verfügung steht.	○	○	○	○	○

66) Wie sehr wären Sie dazu bereit, künftig bei Besatzmassnahmen aktiv mitzuwirken? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht dazu bereit sind, an Besatzmassnahmen mitzuwirken. 100 heisst, dass Sie eine überaus hohe Bereitschaft haben.			Weiss nicht
0	⊢———	100	○



Thema: natürliche Feinde

67) Ich denke bei „natürlichen Feinden“ im Zusammenhang mit Bachforellen an: Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

68) Was fördert bzw. hemmt eine Zunahme der Anzahl natürlicher Feinde von Bachforellen?	
Fördert:	Hemmt:

69) Bitte nennen Sie uns die – aus Ihrer Sicht – bedeutendsten Feinde von Bachforellen
1. _____ 2. _____ 3. _____

Thema: Erhaltung angestammter Bachforellenbestände

70) Wenn Sie „Erhaltung angestammter Bachforellenbestände“ hören, woran denken Sie dann? Bitte notieren Sie alle Stichworte, die Ihnen dabei in den Sinn kommen.

71) Was wirkt sich nach Ihrer Meinung am stärksten positiv bzw. negativ auf die Erhaltung angestammter Bachforellenbestände aus?	
Positiv:	Negativ:

72)	sinnvoll	eher sinnvoll	eher nicht sinnvoll	nicht sinnvoll	Weiss nicht
Wie sinnvoll ist es nach Ihrer Meinung, dass Fische durch Besatzmassnahmen zwischen verschiedenen Flusssystemen ausgetauscht werden?	○	○	○	○	○

Thema: Zufriedenheit und Bewertung

Als nächstes möchten wir gerne erfahren, wie zufrieden Sie mit den verschiedenen bereits angesprochenen Themen sind und wie Sie selber Ihren Kenntnisstand zu den Themengebieten einschätzen.

73) Wie zufrieden sind Sie an dem von Ihnen hauptsächlich genutzten Gewässer mit...	sehr zufrieden	eher zufrieden	weder noch	eher un-zufrieden	sehr un-zufrieden	Weiss nicht
...dem Lebensraum „Fliessgewässer“?	○	○	○	○	○	○
...der Wasserqualität?	○	○	○	○	○	○
...dem Grad der Naturnähe?	○	○	○	○	○	○
...der Strukturvielfalt des Gewässers?	○	○	○	○	○	○
...den Eingriffen des Menschen?	○	○	○	○	○	○
...dem Nahrungsangebot für Bachforellen?	○	○	○	○	○	○
...dem Anteil chemischer Stoffe im Gewässer?	○	○	○	○	○	○
...der Bestandsgrösse von Bachforellen?	○	○	○	○	○	○
...der Naturverlaichung?	○	○	○	○	○	○
...der Fischgesundheit?	○	○	○	○	○	○
...der Bewirtschaftung?	○	○	○	○	○	○
...der Anzahl natürlichen Feinde von Bachforellen?	○	○	○	○	○	○
...der Erhaltung des angestammten Bachforellenbestandes?	○	○	○	○	○	○

74) Als wie hoch schätzen Sie Ihre Kenntnisse in folgenden Bereichen ein?	sehr hoch	eher hoch	weder hoch noch niedrig	eher niedrig	sehr niedrig
Lebensraum „Fliessgewässer“	○	○	○	○	○
Wasserqualität	○	○	○	○	○
Naturnähe von Fliessgewässern	○	○	○	○	○
Strukturvielfalt	○	○	○	○	○
Eingriffe des Menschen am Fliessgewässer	○	○	○	○	○
Nahrungsangebot für Bachforellen	○	○	○	○	○
Chemische Stoffe in Fliessgewässern	○	○	○	○	○
Bestandsgrösse von Bachforellen	○	○	○	○	○
Natürliche Fortpflanzung von Bachforellen	○	○	○	○	○
Bewirtschaftung	○	○	○	○	○
Natürliche Feinde	○	○	○	○	○
Fischgesundheit	○	○	○	○	○
Erhaltung angestammter Bachforellenbestände	○	○	○	○	○

Teil 3: Allgemeine Fragen zu den Themen Natur, Vereine etc.

Den grössten Teil unserer Fragen haben Sie nun hinter sich! In dem folgenden Teil interessieren uns vor allem Ihre Einstellungen und Erfahrungen zu Themen, die nicht direkt mit dem Fischen zu tun haben, aber trotzdem für das Fischen eine grosse Rolle spielen.

75) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Wenn ich mit dem Fischen aufhöre, verliere ich wahrscheinlich den Kontakt zu vielen meiner Freunde.	○	○	○	○	○
Wenn ich nicht fischen gehen könnte, dann wüsste ich nicht, was ich sonst machen könnte.	○	○	○	○	○
Wegen der Fischerei habe ich keine Zeit, an anderen Freizeitaktivitäten teilzunehmen.	○	○	○	○	○
Die meisten meiner Freunde haben in irgendeiner Art und Weise mit Fischerei zu tun.	○	○	○	○	○
Ich halte mich selber für einen Experten in der Fischerei.	○	○	○	○	○
Ich finde, dass ein grosser Teil meines Lebens sich um das Fischen dreht.	○	○	○	○	○
Andere sagen wahrscheinlich, dass ich zu viel Zeit für das Fischen aufwende.	○	○	○	○	○
Ich gehe lieber fischen als irgendetwas anderes zu tun.	○	○	○	○	○
Andere Freizeitaktivitäten interessieren mich nicht so sehr wie das Fischen.	○	○	○	○	○

76)	absolut richtig	eher richtig	eher falsch	absolut falsch	Weiss nicht
Die Vorgaben und Vorschriften der Kantone in Bezug auf die Besatzmassnahmen bei Bachforellen halte ich für...	○	○	○	○	○

77) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Fische und andere Tiere haben die gleichen Rechte wie wir Menschen.	○	○	○	○	○
Gewässer sind isolierte Räume mit begrenztem Fischreichtum.	○	○	○	○	○
Um unsere Bedürfnisse zu befriedigen haben wir Fischer das Recht, die natürlichen Gewässer zu verändern.	○	○	○	○	○
Wenn wir Fischer in ein Gewässer eingreifen, hat das oft negative Konsequenzen zur Folge.	○	○	○	○	○
Das natürliche Gleichgewicht der Gewässer ist stark genug, die Eingriffe durch uns Fischer zu verkraften.	○	○	○	○	○
Wir Fischer nähern uns zahlenmässig der Grenze an, die die Gewässer verkraften können.	○	○	○	○	○
Wir Fischer beeinflussen die Gewässer weniger als andere Gewässernutzer.	○	○	○	○	○
Die Diskussion um den Rückgang von Bachforellenfängen in der Schweiz wird stark übertrieben.	○	○	○	○	○
Wenn wir Fischer so weitermachen wie bisher, werden wir bald eine ökologische Notlage in den Gewässern erleben.	○	○	○	○	○
Wir Fischer sind sehr gut dafür geeignet, die Gewässer zu bewirtschaften und zu schützen.	○	○	○	○	○
Unsere Lernfähigkeit und unsere Beobachtungsgabe als Fischer werden bewirken, dass wir die Gewässer nicht vollständig überfischen.	○	○	○	○	○
Es ist immer noch so, dass wir Fischer viel zu wenig für den Gewässerschutz tun.	○	○	○	○	○
Zugunsten des Gewässerschutzes sollten wir Fischer bereit sein, unsere derzeitigen Fischereiverhaltensweisen zu verändern.	○	○	○	○	○
Durch die Angelfischerei können Bachforellenbestände so weit verringert werden, dass sie sich von alleine nicht wieder erholen.	○	○	○	○	○

78)	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich ziehe den Fang von Wildfischen dem Fang von Fischen aus Besatzmassnahmen vor.	○	○	○	○	○
Wenn ich Wildfische fange, dann bin ich auch mit einem geringeren Tagesfang zufrieden.	○	○	○	○	○

79) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Wenn ich fischen gehe, dann bin ich nicht zufrieden, bis ich nicht irgendetwas gefangen habe.	○	○	○	○	○
Ein Tag an dem ich fischen gehe, kann für mich erfolgreich sein, auch wenn ich keinen Fisch fange.	○	○	○	○	○
Ich bin genau so glücklich, wenn ich fischen gehe und keinen Fisch fange.	○	○	○	○	○

80) Sind Sie Mitglied in einem Fischereiverein oder Club?			
○ Nein (-> Weiter bei ✭, Seite 20, Frage 85)			
○ Ja			
81) Wie viele Mitglieder hat der Verein, in dem Sie Mitglied sind?			
○ bis zu 20	○ 21 – 60	○ 41 – 60	○ mehr als 60

82) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen zu Besatzmassnahmen aus meinem Verein für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Ich äussere meine Meinung zu Besatzmassnahmen, egal was die anderen Vereinsmitglieder denken.	○	○	○	○	○
Im Verein sind es immer die gleichen Leute, die bei Besatzfragen den Ton angeben.	○	○	○	○	○
Der Aufwand, den mein Verein für Besatzmassnahmen betreibt, steht in einem guten Verhältnis zum Ertrag.	○	○	○	○	○
In meinem Verein habe ich die Möglichkeit, mich aktiv an der Besatzplanung zu beteiligen.	○	○	○	○	○

83)	immer	oft	manchmal	selten	nie
Wie oft wird bei Vereinstreffen über Themen, die mit Fischbesatz zu tun haben, gesprochen?	○	○	○	○	○

84)	wichtig	eher wichtig	eher un-wichtig	un-wichtig
Zum Verein dazuzugehören ist mir...	○	○	○	○

★

85) Von wem haben Sie **am meisten** über das Fischen gelernt?
○ Ich habe mir das Fischen selber beigebracht. ○ Im Verein habe ich am meisten über das Fischen gelernt. ○ Verwandte/Familienangehörige haben mir am meisten über das Fischen beigebracht. ○ Ich habe das meiste über das Fischen von anderen gelernt, und zwar von:

86) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen rund um die Fischerei aus meinem familiären Umfeld für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Ich äussere meine Meinung zu Besatzmassnahmen, egal was mein familiäres Umfeld denkt.	○	○	○	○	○

87) Wie stark beabsichtigen Sie, an Besatzmassnahmen teilzunehmen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht beabsichtigen, teilzunehmen. 100 heisst, dass Sie sehr stark beabsichtigen, an Besatzmassnahmen teilzunehmen			Weiss nicht
0	⊢———	100	○

88) Welche Fischarten fangen Sie am häufigsten?

89) Insgesamt bin ich mit dem Fischen in Schweizer Fliessgewässern derzeit... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr unzufrieden	⊢———	sehr zufrieden	○

90) An welchen der folgenden Aktivitäten rund um die Fischerei sind Sie aktiv wie häufig beteiligt?	immer	oft	manchmal	selten	nie	Gibt es bei uns nicht
Abfischungen	○	○	○	○	○	○
Bachputzete	○	○	○	○	○	○
Besatzfischzucht	○	○	○	○	○	○
Fischbesatz	○	○	○	○	○	○
Jungfischerausbildung	○	○	○	○	○	○
Laichfischfang	○	○	○	○	○	○
Mithilfe bei Vereinsanlässen	○	○	○	○	○	○
Renaturierungsmassnahmen	○	○	○	○	○	○
Arbeit im Vereinsvorstand	○	○	○	○	○	○
Sonstiges, und zwar:	○	○	○	○	○	○

91) Wenn Sie sich über wichtige Themen für das Fischen informieren... welche Quellen nutzen Sie?
(Mehrfachnennungen möglich)

- ☐ Fachzeitschriften
- ☐ Vereinszeitung
- ☐ Fernsehen
- ☐ Seminare & Workshops
- ☐ andere Vereinsmitglieder
- ☐ Freundeskreis
- ☐ Behörden
- ☐ andere Quellen, und zwar:
- ☐ Presse
- ☐ andere (befreundete) Fischer
- ☐ Informationsveranstaltungen des Vereins
- ☐ Internet
- ☐ Informationsveranstaltungen ausserhalb des Vereins
- ☐ Familie
- ☐ FIBER

92) Fischen Sie ausschliesslich in Schweizer Gewässern oder fischen Sie ebenfalls im Ausland?

- ○ Nein, ich fische nur in der Schweiz.
- ○ Ja, ich fische auch im Ausland. Und zwar in folgendem/n Land/Ländern:

93) Wenn Sie auch im Ausland fischen, was ist aus Ihrer Sicht der Hauptunterschied zum Fischen in Schweizer Gewässern? Was bietet Ihnen das Fischen im Ausland, das Ihnen in Schweizer Gewässern fehlt?

Haben Sie an der Abfischung im Herbst teilgenommen?	○ Ja	○ Nein	○ Fand noch nicht statt

Teil 4: Ihre Anregungen, Fragen und Rückmeldungen zu dieser Befragung

In diesem letzten Teil des Fragebogens würden wir gerne von Ihnen wissen, wie Sie die Bearbeitung unseres Fragebogens fanden.

94) Wie sind Sie auf diese Umfrage aufmerksam geworden?

- ○ Ich habe den Fragebogen per Post erhalten.
- ○ Ich habe den Fragebogen im Internet unter www.fischer.eawag.ch bestellt bzw. selber ausgedruckt.
- ○ Ich habe den Fragebogen von meinem Verein erhalten.
- ○ Ich habe den Fragebogen von einem Freund oder Bekannten bekommen.
- ○ Der Fragebogen lag in einem Geschäft aus.
- ○ Ich habe den Fragebogen auf einem anderen Weg bekommen, und zwar:

95) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Bei der Bearbeitung dieses Fragebogens musste ich öfter lange nachdenken.	○	○	○	○	○

96) In diesem Fragebogen wurden – aus meiner Sicht – alle wichtigen Themen rund um die Fischerei behandelt.

- ○ Ja
- ○ Nein, es fehlte:

97) Gab es in diesem Fragebogen Themen, über die Sie vorher noch nie nachgedacht haben? (Mehrfachnennungen möglich)		
○ Nein		
○ Ja, und zwar über:		
☐ Lebensraum „Fliessgewässer“	☐ Bewirtschaftung	☐ Naturnähe
☐ chemische Stoffe	☐ Wasserqualität	☐ Beschaffenheit der Gewässer
☐ Eingriffe durch den Menschen	☐ Bestandsgrösse	☐ Besatzmassnahmen
☐ Fischgesundheit	☐ Nahrungsangebot	☐ Fortpflanzung/Naturverlaichung
☐ Erhaltung angestammter Forellenarten	☐ natürliche Feinde	☐ Anderes Thema:_____

98) Wenn Sie jetzt einmal an diesen Fragebogen denken, in welchem Ausmass konnten Sie Ihre Erfahrungen und Ihre Kenntnisse als Fischer einbringen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht.		
gar nicht	├──┤	vollständig

99) Gibt es noch etwas, das Sie uns gerne mitteilen möchten? Fragen, Anregungen und Kritik sind herzlich willkommen!

Wenn Sie eine Rückmeldung zu Ihren Angaben erhalten möchten, füllen Sie bitte folgende Felder aus:	
Welches sind die **ersten beiden** Buchstaben Ihres Voramens?	[ ] [ ]
Welches sind die **letzten beiden** Buchstaben Ihres Nachnamens?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben des Ortes, in dem Sie wohnen?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben der Strasse, in der Sie wohnen?	[ ] [ ]
Achtung! Bitte tragen Sie genau die gleichen Buchstaben in das Rückmeldungsformular ein. Ansonsten können wir Ihnen keine Rückmeldung zu Ihren Angaben zukommen lassen. Eine Weitergabe Ihrer persönlichen Daten an Dritte findet selbstverständlich nicht statt.	

Herzlichen Dank, dass Sie sich die Zeit genommen haben!
Ihre Angaben sind sehr wichtig für uns und Sie haben uns damit sehr unterstützt!

XIV.3.2 Short questionnaire after interim report (Stage III.2)

Dübendorf, d. 13.11.2009

[Anschrift]

Liebe Fischerin, lieber Fischer,

An dieser Stelle ein herzliches Dankeschön an diejenigen von Ihnen, die uns bereits vor ca. einem halben Jahr bei unserer ersten Umfrage geholfen und überaus wertvolle Rückmeldungen gegeben haben!
Heute wenden wir uns nochmals (wie bei Projektbeginn angekündigt) mit ein paar wenigen Fragen an Sie, deren Beantwortung für das Projekt „Erfolgskontrolle Bachforellenbesatz“, an dem auch Ihr Verein teilnimmt, sehr wichtig ist.

Warum diese (erneute) Befragung?
In unserer Pilotstudie haben wir nach allen möglichen Faktoren gefragt, die in Interviews von verschiedenen Fischern als wichtig genannt wurden. Die Auswertung dieser Umfrage hat gezeigt, dass wir uns auf zentrale Punkte beschränken können, nämlich hauptsächlich auf Ihre Erfahrungen mit Fischbesatz, Bachforellenbeständen und bestimmten Aspekten zum Lebensraum Fliessgewässer. Insbesondere interessiert uns, welche Auswirkung die Ergebnisse von Bachforellenbesatz aus Ihrer Sicht auf die zukünftige Planung von Besatzmassnahmen haben. Damit die Ergebnisse dieser Folgebefragung mit den Ergebnissen der ersten Studie vergleichbar sind, müssen wir einige Fragen aus der Pilotstudie erneut stellen.
Insgesamt sind in der Studie zur Erfolgskontrolle Bachforellenbesatz ein bis zwei kurze Folgebefragungen und eine Abschlussbefragung geplant. Eine sinnvolle Auswertung des Projektes können wir aber nur vornehmen, wenn sich sehr viele Fischer und Fischerinnen aus Ihrem Verein an den Befragungen beteiligen. Teilnehmen können sowohl Fischer, die bereits an der langen Befragung teilgenommen haben als auch Leute, die den ersten Fragebogen nicht erhalten haben oder die dessen Länge von der Teilnahme abgehalten hat. Als „Dankeschön“ für Ihren Aufwand werden wir Sie über die Ergebnisse des Projektes ausführlich informieren und die Ergebnisse der Markierungs- und Wiederfanguntersuchungen in Ihrem Vereinsgewässer mit Ihnen diskutieren (Frühjahr/Mitte 2010).
Daher helfen Sie uns sehr, wenn Sie sich **ca. 10 Minuten** Zeit nehmen und diesen Fragebogen ausfüllen.

Was passiert mit den Ergebnissen?
Die Ergebnisse werden wir per Computer erfassen und auswerten. Ihre persönlichen Angaben nutzen wir nur für die Rückmeldung, die Auswertung erfolgt selbstverständlich vollständig anonymisiert!

Wohin mit dem ausgefüllten Fragebogen?
Bitte senden Sie uns den Fragebogen bis zum **4.12.2009** zurück. Damit Ihnen keinerlei Kosten entstehen, haben wir Ihnen ein bereits adressiertes Retourcouvert für den ausgefüllten Fragebogen beigefügt.

Bereits jetzt möchten wir uns für Ihre Teilnahme an dieser Umfrage herzlich bedanken!

gez.

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Teil 1: Statistische Angaben

Bitte füllen Sie die folgenden Felder aus, damit wir Ihre Angaben richtig zuordnen können. Durch diese Art der Zuordnung können wir Ihnen absolute Anonymität garantieren.	
Welches sind die **ersten beiden** Buchstaben Ihres Voramens?	[ ] [ ]
Welches sind die **letzten beiden** Buchstaben Ihres Nachnamens?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben des Ortes, in dem Sie wohnen?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben der Strasse, in der Sie wohnen?	[ ] [ ]
1) In welchem Jahr sind Sie *geboren*?	[ ]
2) Vor wie vielen Jahren haben Sie mit dem *Fischen* begonnen?	[ ]
3) Wie viele Gewässer befischen Sie regelmässig?	[ ]
4) An wie vielen Tagen gehen Sie im Jahr durchschnittlich fischen?	[ ]

5) Gehört XXX zu den Gewässern, die Sie aktiv befischen?	○ Ja	○ Nein
6) Haben Sie an Markierung und Besatz der Besatzfische im **Sommer/Herbst 08** teilgenommen?	○ Ja	○ Nein
7) Haben Sie an der Abfischung im **Herbst 08** teilgenommen?	○ Ja	○ Nein
8) Haben Sie an der Abfischung im **Frühjahr 09** teilgenommen?	○ Ja	○ Nein
9) Haben Sie die Projekt-Berichte von Ihrem Verein erhalten?	○ Ja	○ Nein
Falls „Nein“: Sie können die Projekt-Berichte unter Tel.: 044 823 5534 bei uns bestellen.		

10) Wie beurteilen Sie die Verständlichkeit der verschiedenen Teile des Besatzerfolg-Berichtes?	sehr verständ-lich	eher verständ-lich	teils-teils	eher un-verständ-lich	sehr un-verständ-lich	Habe ich nicht gelesen
A. Hintergründe und Beweggründe der Untersuchung	○	○	○	○	○	○
B. Beschreibung des Vorgehens	○	○	○	○	○	○
C. Darstellung der Ergebnisse	○	○	○	○	○	○
D. Sonstiges:	○	○	○	○	○	○

Teil 2: Ihre Erfahrungen und Einschätzungen

Die Fische und Fischerei sind ein sehr vielschichtiges Thema. In dieser Studie haben wir die Schwerpunkte auf die Themen Naturverlaichung, Fischbesatz und Grösse von Bachforellenbeständen gelegt.

Thema: Naturverlaichung

11) Wie beurteilen Sie den Grad der Naturverlaichung in dem Gewässer, dass Sie hauptsächlich befischen?

- ○ voll und ganz ausreichend für einen guten Bestand
- ○ eher ausreichend für einen guten Bestand
- ○ eher nicht ausreichend für einen guten Bestand
- ○ ganz und gar nicht ausreichend für einen guten Bestand
- ○ Das weiss ich nicht.

Thema: Fischbesatz & Grösse von Bachforellenbeständen

12) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Unabhängig von der natürlichen Fortpflanzung sollte Bachforellenbesatz durchgeführt werden.	○	○	○	○	○

13) Was denken Sie? Wie viel Prozent der Fische, die Sie fangen, stammen aus Besatzmassnahmen?	ca.____%

14) Insgesamt beurteile ich Besatzmassnahmen als... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr erfolgreich	⊢——————⊣	gar nicht erfolgreich	○

15) Insgesamt bin ich mit Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr zufrieden	⊢——————⊣	gar nicht zufrieden	○

16) Ich halte Fischbesatz als Bewirtschaftungsmassnahme in...	sehr gut	eher gut	weder gut noch schlecht	eher schlecht	sehr schlecht	Weiss nicht
...*naturnahen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturnahen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○

17) Insgesamt finde ich Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gut	⊢——————⊣	sehr schlecht	○

18) Welche Bewirtschaftungsmethoden halten Sie für am besten geeignet, um die Bestandsgrösse von Bachforellen zu verbessern?

Bitte bringen Sie die folgenden Bewirtschaftungsmethoden in die Reihenfolge, die für Sie am besten zutrifft. Bei „1." tragen Sie das Kürzel der Methode (z.B. „D" für Schongebiete) ein, die Sie für am besten geeignet halten und bei „7." die Methode, die Sie für am wenigsten geeignet halten. Jeder Zahl darf nur ein Kürzel zugeordnet werden.

1.____	**A** Besatz
2.____	**B** Schonmasse
3.____	**C** Schonzeit
4.____	**D** Schongebiete
5.____	**E** Fangzahlbeschränkung
6.____	**F** Beschränkung Anzahl Angeltage (oder Angler)
7.____	**G** Fischereiverbote

Thema: Verein und andere Aktivitäten

	immer	oft	manchmal	selten	nie
19) Wie oft wird bei Vereinstreffen über Themen, die mit Fischbesatz zu tun haben, gesprochen?	○	○	○	○	○
20) Wie häufig nehmen Sie aktiv an Fischbesatzmassnahmen teil?	○	○	○	○	○

21) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen zu Besatzmassnahmen aus meinem Verein für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Der Aufwand, den mein Verein für Besatzmassnahmen betreibt, steht in einem guten Verhältnis zum Ertrag.	○	○	○	○	○
In meinem Verein habe ich die Möglichkeit, mich aktiv an der Besatzplanung zu beteiligen.	○	○	○	○	○

22) Der Einfluss meines Vereins auf meine Meinung zu Fischbesatz und Bewirtschaftung ist... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gering	⊢——————————⊣	sehr hoch	○

23) Wie stark beabsichtigen Sie, *künftig* an Besatzmassnahmen teilzunehmen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht beabsichtigen, teilzunehmen. 100 heisst, dass Sie sehr stark beabsichtigen, an Besatzmassnahmen teilzunehmen			Weiss nicht
0	⊢——————————⊣	100	○

Thema: Umwelt und Bachforellen

Viele Dinge spielen eine Rolle für Bachforellen in Fliessgewässern. In den folgenden Fragen finden Sie eine Auswahl an Themenbereichen, die in der Pilotstudie für viele Fischer eine wichtige Rolle bei der Beurteilung von Fliessgewässern spielten. Bitte kreuzen Sie nur jeweils die Antwort an, die aus Ihrer ganz persönlichen Sicht den **stärksten Einfluss** auf das entsprechende Themengebiet hat.

24) Was hat aus Ihrer ganz persönlichen Sicht den **stärksten negativen Einfluss auf die Gesundheit von Bachforellen**?

- ○ hohe Wassertemperatur
- ○ schlechte Wasserqualität
- ○ schlechter Lebensraum
- ○ hohe (chemische) Belastungen

Bei meiner Einschätzung bin ich mir... ○ sehr sicher ○ eher sicher ○ eher unsicher ○ sehr unsicher

25) Was hat aus Ihrer ganz persönlichen Sicht den **stärksten negativen Einfluss auf die Erhaltung angestammter Bachforellenbeständen**?

- ○ mehr Fischerei
- ○ schlechte Wasserqualität
- ○ hohe (chemische) Belastungen
- ○ schlechte Wassersituation (Sunk- und Schwall etc.)
- ○ geringe Naturnähe
- ○ mehr natürliche Feinde
- ○ mehr Besatzmassnahmen im Allgemeinen
- ○ Besatzmassnahmen mit Fischen aus einem anderen Gewässer

Bei meiner Einschätzung bin ich mir... ○ sehr sicher ○ eher sicher ○ eher unsicher ○ sehr unsicher

26) Was hat aus Ihrer ganz persönlichen Sicht den **stärksten positiven Einfluss auf das Nahrungsangebot für Bachforellen**?

- ○ gute Wasserqualität
- ○ gute Beschaffenheit des Gewässergrunds
- ○ hohe Naturnähe
- ○ hohe Strukturvielfalt
- ○ guter Lebensraum

Bei meiner Einschätzung bin ich mir... ○ sehr sicher ○ eher sicher ○ eher unsicher ○ sehr unsicher

27) Was hat aus Ihrer ganz persönlichen Sicht den **stärksten positiven Einfluss auf die Strukturvielfalt eines Fliessgewässers?**				
	○ gute Wassersituation (kein Schwall und Sunk, etc.) ○ guter Lebensraum ○ gute Beschaffenheit des Gewässergrunds ○ hohe Naturnähe ○ gute Renaturierungsmassnahmen ○ hohe Durchgängigkeit und Vernetztheit der Gewässer			
Bei meiner Einschätzung bin ich mir...	○ sehr sicher	○ eher sicher	○ eher unsicher	○ sehr unsicher

28) Was hat aus Ihrer ganz persönlichen Sicht den **stärksten positiven Einfluss auf die Grösse von Bachforellenbeständen**?				
	○ hohe Naturnähe ○ hohe Strukturvielfalt ○ mehr Besatzmassnahmen ○ mehr natürliche Fortpflanzung ○ geringe Wassertemperatur ○ guter Lebensraum ○ hohes Nahrungsangebot			
Bei meiner Einschätzung bin ich mir...	○ sehr sicher	○ eher sicher	○ eher unsicher	○ sehr unsicher

29) Wie schätzen Sie die Ergebnisse der Besatzmarkierungen und Kontrollabfischungen (siehe Ergebnisberichte) ein?
○ Fischbesatz ist erfolgreicher, als ich dachte. ○ Der Besatzerfolg passt im Grossen und Ganzen zu meinen Erwartungen. ○ Fischbesatz ist erfolgloser, als ich dachte. ○ Das weiss ich nicht.

30) Welche Bedeutung haben die Besatzerfolgs-Ergebnisse für Sie persönlich?	Trifft voll und ganz zu	Trifft eher zu	teils-teils	Trifft eher nicht zu	Trifft ganz und gar nicht zu	Weiss nicht
Die Ergebnisse haben mich dazu angeregt, über Besatzmassnahmen nachzudenken.	○	○	○	○	○	○
Die Ergebnisse haben mich dazu angeregt, mit anderen über Besatzmassnahmen zu diskutieren.	○	○	○	○	○	○
Die Ergebnisse sprechen dafür, dass Fliessgewässer so funktionieren, wie ich denke.	○	○	○	○	○	○
Aufgrund der Ergebnisse muss ich meine Vorstellung zu Fliessgewässern überdenken.	○	○	○	○	○	○

Teil 3: Ihre Anregungen, Fragen und Rückmeldungen

31) Gibt es noch etwas, das Sie uns gerne mitteilen möchten? Fragen, Anregungen und Kritik sind herzlich willkommen!

Herzlichen Dank, dass Sie sich die Zeit genommen haben!
Ihre Angaben sind sehr wichtig für uns und Sie haben uns damit sehr unterstützt!

XIV.3.3 Short questionnaire after final report (Stage III.3)

Dübendorf, d. XX.XX.2010

[Anschrift]

Liebe Fischerin, lieber Fischer,

Das Projekt „Erfolgskontrolle Bachforellenbesatz“, an dem auch Ihr Verein teilnimmt, ist nun fast abgeschlossen. Die Abschlussberichte sind versendet und mit Ihrem Verein wurde ein Termin für die Abschlussbesprechung vereinbart. Neben den bereits abgeschlossenen Besatzmarkierungen und Kontrollabfischungen sind die Umfragen ein sehr wichtiger Bestandteil des Projekts und für uns notwendig, um das Projekt abschliessen zu können.

Heute wenden wir uns nochmals (wie bei Projektbeginn angekündigt) mit ein paar wenigen Fragen an Sie, mit deren Beantwortung Sie unser gemeinsames Projekt „Erfolgskontrolle Bachforellenbesatz“ sehr unterstützen. Darüber hinaus möchten wir Ihnen die Gelegenheit geben, uns eine Rückmeldung zu dem Abschlussbericht zukommen zu lassen.

Warum diese (erneute) Befragung?
In unserem Projekt möchten wir erfahren, welche Erfahrungen Sie mit Fischbesatz, Bachforellenbeständen und bestimmten Aspekten zum Lebensraum Fliessgewässer haben. Insbesondere interessiert uns, welche Auswirkung die Bachforellenbesatz-Ergebnisse aus Ihrer Sicht auf die zukünftige Planung von Besatzmassnahmen haben. Damit diese Befragung mit den Ergebnissen der vorherigen Befragungen vergleichbar ist, müssen wir einige Fragen erneut stellen. Bitte beantworten Sie diese mit der gleichen Sorgfalt wie bei den vorherigen Befragungen, auch wenn die Fragen sich zum Teil wiederholen.
Eine sinnvolle Auswertung des Projektes können wir nur vornehmen, wenn sich sehr viele Fischer und Fischerinnen aus Ihrem Verein an den Befragungen beteiligen. Teilnehmen können sowohl Fischer, die bereits an einer Befragung teilgenommen haben als auch Leute, die die ersten Fragebögen nicht erhalten haben oder die die Länge von der Teilnahme abgehalten hat. Als „Dankeschön“ für Ihren Aufwand werden wir Sie über die Ergebnisse des Projektes ausführlich informieren und die Ergebnisse der Markierungs- und Wiederfanguntersuchungen in Ihrem Vereinsgewässer mit Ihnen diskutieren.
Daher helfen Sie uns sehr, wenn Sie sich **ca. 10 Minuten** Zeit nehmen und diesen Fragebogen ausfüllen.

Was passiert mit den Ergebnissen?
Die Ergebnisse werden wir per Computer erfassen, auswerten und für rein wissenschaftliche Zwecke nutzen. Ihre persönlichen Angaben nutzen wir nur für die Rückmeldung, die Auswertung erfolgt selbstverständlich vollständig anonymisiert!

Wohin mit dem ausgefüllten Fragebogen?
Bitte senden Sie uns den Fragebogen bis zum **14.03.2010** zurück. Damit Ihnen keinerlei Kosten entstehen, haben wir Ihnen ein bereits adressiertes Retourcouvert für den ausgefüllten Fragebogen beigefügt.

Bereits jetzt möchten wir uns für Ihre Teilnahme an dieser Umfrage herzlich bedanken!

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Susanne Haertel-Borer
Eawag, Abteilung Fischökologie und -evolution
Seestrasse 79
CH- 6047 Kastanienbaum

Teil 1: Statistische Angaben

Bitte füllen Sie die folgenden Felder aus, damit wir Ihre Angaben richtig zuordnen können. Wir sichern Ihnen selbstverständlich eine vollständig anonymisierte Auswertung zu.	
Welches sind die **ersten beiden** Buchstaben Ihres Vornamens?	[ ] [ ]
Welches sind die **letzten beiden** Buchstaben Ihres Nachnamens?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben des Ortes, in dem Sie wohnen?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben der Strasse, in der Sie wohnen?	[ ] [ ]

Wie häufig haben Sie während des Projektzeitraums **(Herbst 08 – Herbst 09)**...	immer	gelegent-lich	nie	Weiss nicht
...an Markierung und Besatz der Besatzfische teilgenommen?	○	○	○	○
...an Kontrollabfischungen teilgenommen?	○	○	○	○
...die Projektberichte erhalten und gelesen?	○	○	○	○

9) Haben Sie den **Projekt-Abschlussbericht** erhalten?	○ Ja	○ Nein
Falls „Nein“: Sie können die Projekt-Berichte unter Tel.: 044 823 5534 bei uns bestellen.		

10) Wie beurteilen Sie die Verständlichkeit der verschiedenen Teile des Abschluss-berichtes?	sehr verständ-lich	eher verständ-lich	teils-teils	eher un-verständ-lich	sehr un-verständ-lich	Habe ich nicht gelesen
A. Hintergründe und Beweggründe	○	○	○	○	○	○
B. Beschreibung des Vorgehens	○	○	○	○	○	○
C. Darstellung der Ergebnisse	○	○	○	○	○	○
D. Sonstiges:	○	○	○	○	○	○

Teil 2: Ihre Erfahrungen und Einschätzungen

Die Fische und Fischerei sind ein sehr vielschichtiges Thema. In dieser Studie haben wir die Schwerpunkte auf die Themen Naturverlaichung, Fischbesatz und Grösse von Bachforellenbeständen gelegt.

Thema: Naturverlaichung

11) Wie beurteilen Sie den Grad der Naturverlaichung in der [Gewässer]?
○ voll und ganz ausreichend für einen guten Bestand ○ eher ausreichend für einen guten Bestand ○ eher nicht ausreichend für einen guten Bestand ○ ganz und gar nicht ausreichend für einen guten Bestand ○ Das weiss ich nicht. ○ Ich befische die [Gewässer] nicht aktiv.

12) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Unabhängig von der natürlichen Fortpflanzung sollte Bachforellenbesatz durchgeführt werden.	○	○	○	○	○

Thema: Einschätzung von und Erfahrung mit Besatzmassnahmen

13) Was denken Sie? Wie viel Prozent der Fische, die Sie fangen, stammen aus Besatzmassnahmen?	ca.____%

14) Insgesamt beurteile ich Besatzmassnahmen als... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
gar nicht erfolgreich	⊢——————⊣	sehr erfolgreich	○

15) Insgesamt bin ich mit Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
gar nicht zufrieden	⊢——————⊣	sehr zufrieden	○

16) Ich halte Fischbesatz als Bewirtschaftungsmassnahme in...	sehr gut	eher gut	weder gut noch schlecht	eher schlecht	sehr schlecht	Weiss nicht
...*naturnahen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturnahen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○

Wie gut werden die folgenden Ziele durch Bachforellenbesatz Ihrer Meinung nach erreicht?	voll und ganz	eher ja	teils-teils	eher nein	ganz und gar nicht	Weiss nicht
Mehr Fische für Fischer zu haben	○	○	○	○	○	○
Ausgleich hoher Entnahmemengen durch natürliche Feinde	○	○	○	○	○	○
Ausgleich von Auswirkungen der Fischerei	○	○	○	○	○	○
Ausgleich einer mangelhaften natürlichen Fortpflanzung.	○	○	○	○	○	○
Ausgleich natürlicher Schwankungen in der Bestandsgrösse.	○	○	○	○	○	○
In allen Fliessgewässern Forellen fangen zu können.	○	○	○	○	○	○
Dem Grundsatz „Wer ernten will, muss säen“ zu folgen.	○	○	○	○	○	○
Anderer Ziel, und zwar:	○	○	○	○	○	○

17) Insgesamt finde ich Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr schlecht	⊢——————⊣	sehr gut	○

Thema: Umwelt, Bewirtschaftung und Grösse von Bachforellenbeständen
Viele Dinge spielen eine Rolle für Bachforellen in Fliessgewässern. In den folgenden Fragen finden Sie eine Auswahl an Themenbereichen, die in der Pilotstudie für viele Fischer eine wichtige Rolle für die Bestandsgrösse spielten.

Wie schätzen Sie die Wirkung folgender Einflüsse für die **Grösse von Bachforellenbeständen** in der [Name] ein?	sehr gut	eher gut	hat keinen Einfluss	eher schlecht	sehr schlecht	Gibt es bei uns nicht
Renaturierungsmassnahmen	○	○	○	○	○	○
Anzahl natürlicher Feinde	○	○	○	○	○	○
Naturverlaichung/natürliche Fortpflanzung	○	○	○	○	○	○
Unterstände & Verstecke	○	○	○	○	○	○
Naturnähe der [Name]	○	○	○	○	○	○
Verbauungen & Schwellen	○	○	○	○	○	○
Besatzmassnahmen	○	○	○	○	○	○
Fischerei	○	○	○	○	○	○
Wasserkraftnutzung	○	○	○	○	○	○
Schongebiete	○	○	○	○	○	○
Abwasserreinigungsanlagen/Klärwerke	○	○	○	○	○	○
Fischtreppen	○	○	○	○	○	○
Wasserqualität der [Gewässername]	○	○	○	○	○	○
Gesundheitszustand der Fische	○	○	○	○	○	○
Nahrungsangebot in der [Name]	○	○	○	○	○	○
Lebensraum [Name] im Allgemeinen	○	○	○	○	○	○
Schonmasse	○	○	○	○	○	○
Schonzeiten	○	○	○	○	○	○
Fangzahlbeschränkung	○	○	○	○	○	○
Sonstiges:	○	○	○	○	○	○

29) Bei diesen Einschätzungen bin ich mir insgesamt...			
○ sehr sicher	○ eher sicher	○ eher unsicher	○ sehr unsicher

Thema: Verein

	immer	oft	manchmal	selten	nie
19) Wie oft wird bei Vereinstreffen über Themen, die mit Fischbesatz zu tun haben, gesprochen?	○	○	○	○	○
20) Wie häufig nehmen Sie aktiv an Fischbesatzmassnahmen teil?	○	○	○	○	○

17n) Ich denke, der Grossteil der Vereinsmitglieder findet Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr schlecht	⊢——————————⊣	sehr gut	○

21) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen zu Besatzmassnahmen aus meinem Verein für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Der Aufwand, den mein Verein für Besatzmassnahmen betreibt, steht in einem guten Verhältnis zum Ertrag.	○	○	○	○	○
In meinem Verein habe ich die Möglichkeit, mich aktiv an der Besatzplanung zu beteiligen.	○	○	○	○	○

22) Der Einfluss meines Vereins auf meine Meinung zu Fischbesatz ist... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gering	├──────────────────────────────────────┤	sehr hoch	○

23) Wie stark beabsichtigen Sie, *künftig* an Besatzmassnahmen teilzunehmen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht. 0 bedeutet, dass Sie nicht beabsichtigen, teilzunehmen. 100 heisst, dass Sie sehr stark beabsichtigen, an Besatzmassnahmen teilzunehmen			Weiss nicht
0	├──────────────────────────────────────┤	100	○

Thema: Ergebnisse Besatzstudie

29) Wie schätzen Sie die Ergebnisse der Besatzmarkierungen und Kontrollabfischungen (*siehe Abschlussbericht*) ein?

- ○ Fischbesatz ist erfolgreicher, als ich dachte.
- ○ Der Besatzerfolg passt im Grossen und Ganzen zu meinen Erwartungen.
- ○ Fischbesatz ist erfolgloser, als ich dachte.
- ○ Das weiss ich nicht.

30) Welche Bedeutung haben die Ergebnisse des Abschlussberichts für Sie persönlich? Die Ergebnisse...	Trifft voll und ganz zu	Trifft eher zu	teils-teils	Trifft eher nicht zu	Trifft ganz und gar nicht zu	Weiss nicht
...haben mich dazu angeregt, über Besatzmassnahmen nachzudenken.	○	○	○	○	○	○
...haben mich dazu angeregt, mit anderen über Besatzmassnahmen zu diskutieren.	○	○	○	○	○	○
...sprechen dafür, dass Fliessgewässer so funktionieren, wie ich denke.	○	○	○	○	○	○
Aufgrund der Ergebnisse muss ich meine Vorstellung zu Fliessgewässern überdenken.	○	○	○	○	○	○

Teil 3: Ihre Anregungen, Fragen und Rückmeldungen

31) Gibt es noch etwas, das Sie uns gerne mitteilen möchten? Fragen, Anregungen und Kritik sind herzlich willkommen!

Herzlichen Dank, dass Sie sich die Zeit genommen haben!
Ihre Angaben sind sehr wichtig für uns und Sie haben uns damit sehr unterstützt!

XIV.3.4 Short questionnaire after workshop (Stage III.4)

Teil 1: Statistische Angaben

Bitte füllen Sie die folgenden Felder aus, damit wir Ihre Angaben richtig zuordnen können. Wir sichern Ihnen selbstverständlich eine vollständig anonymisierte Auswertung zu.	
Welches sind die **ersten beiden** Buchstaben Ihres Vornamens?	[ ] [ ]
Welches sind die **letzten beiden** Buchstaben Ihres Nachnamens?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben des Ortes, in dem Sie wohnen?	[ ] [ ]
Welches sind die **ersten beiden** Buchstaben der Strasse, in der Sie wohnen?	[ ] [ ]
In welchem Jahr sind Sie **geboren**?	[ ]

1) Wie häufig haben Sie während des Projektzeitraums **(Herbst 08 – Herbst 09)**...	immer	gelegent-lich	nie	Weiss nicht
...an Markierung und Besatz der Besatzfische am [Gewässer] teilgenommen?	○	○	○	○
...an Projekt-Kontrollabfischungen teilgenommen?	○	○	○	○
...die Projektberichte erhalten und gelesen?	○	○	○	○

2) Haben Sie den **Projekt-Abschlussbericht** erhalten?	○ Ja	○ Nein

3) Wie beurteilen Sie die Aussagekraft der verschiedenen Teile der **Abschluss-besprechung**?	sehr hoch	eher hoch	teils-teils	eher gering	sehr gering	Weiss nicht
Ergebnisse der Umfragen	○	○	○	○	○	○
Ergebnisse der Kontrollabfischungen	○	○	○	○	○	○
Das Projekt „Efolgskontrolle Bachforellenbesatz“ insgesamt	○	○	○	○	○	○
Sonstiges:	○	○	○	○	○	○

Teil 2: Ihre Erfahrungen und Einschätzungen

Die Fische und Fischerei sind ein sehr vielschichtiges Thema. In dieser Studie haben wir die Schwerpunkte auf die Themen Naturverlaichung, Fischbesatz und Grösse von Bachforellenbeständen gelegt.

Thema: Naturverlaichung

4) Wie beurteilen Sie den Grad der Naturverlaichung im [Gewässer]?
○ voll und ganz ausreichend für einen guten Bestand ○ eher ausreichend für einen guten Bestand ○ eher nicht ausreichend für einen guten Bestand ○ ganz und gar nicht ausreichend für einen guten Bestand ○ Das weiss ich nicht. ○ Ich befische das [Gewässer] nicht aktiv.

5) In wie weit stimmen Sie folgender Aussage zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Unabhängig von der natürlichen Fortpflanzung sollte Bachforellenbesatz durchgeführt werden.	○	○	○	○	○
Die Besatzmenge sollte davon abhängen, wie viel Lebensraum zur Verfügung steht.	○	○	○	○	○

6) Wie sehr wären Sie dazu bereit, *künftig* bei Besatzmassnahmen aktiv mitzuwirken? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht.			Weiss nicht
gar nicht	⊢——————————⊣	sehr stark	○

Thema: Einschätzung von und Erfahrung mit Besatzmassnahmen

7) Was denken Sie? Wie viel Prozent der Fische, die Sie fangen, stammen aus Besatzmassnahmen?	ca.____%

8) Dieser Anteil der Besatzfische an Ihrem Fang spricht dafür, dass die Besatzmassnahmen...

- ○ sehr erfolgreich waren
- ○ eher erfolgreich waren
- ○ eher nicht erfolgreich waren
- ○ gar nicht erfolgreich waren
- ○ Das weiss ich nicht

9) Insgesamt beurteile ich Besatzmassnahmen als... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
gar nicht erfolgreich	⊢——————————⊣	sehr erfolgreich	○

10) Insgesamt bin ich mit Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
gar nicht zufrieden	⊢——————————⊣	sehr zufrieden	○

11) Ich halte Fischbesatz als Bewirtschaftungsmassnahme in...	sehr gut	eher gut	weder gut noch schlecht	eher schlecht	sehr schlecht	Weiss nicht
...*naturnahen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturnahen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit hohem nat. Jungfischaufkommen für...	○	○	○	○	○	○
...*naturfernen* Fliessgewässern mit geringem nat. Jungfischaufkommen für...	○	○	○	○	○	○
Die Auswirkungen von Bachforellenbesatz sind für funktionierende Naturverlaichung...	○	○	○	○	○	○

12) Insgesamt finde ich Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr schlecht	⊢——————————⊣	sehr gut	○

13) Welche Bewirtschaftungsmethode halten Sie für am besten geeignet, um die Bestandsgrösse von Bachforellen zu verbessern?
Bitte nummerieren Sie die folgenden Bewirtschaftungsmethoden in der Reihenfolge, die Ihre Meinung am besten widerspiegelt. Schreiben Sie bitte ein „1“ vor die Methode, die Sie für am besten geeignet halten und ein „7“ vor die Methode, die Sie für am wenigsten geeignet halten. Bitte vergeben Sie jede Zahl nur ein Mal.

- ___ Besatzmassnahmen
- ___ Schonmasse
- ___ Schonzeit
- ___ Schongebiete
- ___ Fangzahlbeschränkungen
- ___ Beschränkung Anzahl Angeltage (oder Angler)
- ___ Fischereiverbote

14) Wie notwendig sind **Besatzmassnahmen** im [Gewässer] durch die folgenden Einflussgrössen? Besatzmassnahmen im [Gewässer] sind wegen...	sehr not-wendig	eher not-wendig	hat keinen Einfluss	eher nicht not-wendig	gar nicht not-wendig	Gibt es bei uns nicht
...Renaturierungsmassnahmen	○	○	○	○	○	○
...der Anzahl natürlicher Feinde	○	○	○	○	○	○
...der natürlichen Fortpflanzung	○	○	○	○	○	○
...der Unterstände & Verstecke	○	○	○	○	○	○
...des Grads der Naturnähe des [Gewässers]	○	○	○	○	○	○
...der Verbauungen & Schwellen	○	○	○	○	○	○
...der Grösse des Bachforellenbestands	○	○	○	○	○	○
...der Fischerei	○	○	○	○	○	○
...der Wasserkraftnutzung	○	○	○	○	○	○
...Schongebieten	○	○	○	○	○	○
...Abwasserreinigungsanlagen/Klärwerken	○	○	○	○	○	○
...Fischtreppen	○	○	○	○	○	○
...der Wasserqualität des [Gewässers]	○	○	○	○	○	○
...des Gesundheitszustandes der Fische	○	○	○	○	○	○
...des Nahrungsangebots im [Gewässer]	○	○	○	○	○	○
...des Lebensraums [Gewässer] im Allgemeinen	○	○	○	○	○	○
...Schonmasse	○	○	○	○	○	○
...Schonzeiten	○	○	○	○	○	○
...Fangzahlbeschränkungen	○	○	○	○	○	○
Sonstiges:	○	○	○	○	○	○

15) Bei diesen Einschätzungen bin ich mir insgesamt...			
○ sehr sicher	○ eher sicher	○ eher unsicher	○ sehr unsicher

16) In wie weit stimmen Sie folgender Aussage zu?	machbar	eher machbar	eher nicht machbar	gar nicht machbar	Weiss nicht
Mit Besatzmassnahmen aufzuhören und heutzutage trotzdem erfolgreich zu fischen, dass halte ich für...	○	○	○	○	○



17) Es gibt verschiedene Gründe und Ursachen, warum Forellenbestände abnehmen. Für welche der folgenden denkbaren Gründe ist der Besatz mit **Jungfischen** eine gute Massnahme?
(Mehrfachnennungen möglich)

- ☐ geringes Nahrungsangebot
- ☐ schlechte Wasserqualität
- ☐ Mangel an Laichplätzen oder unzureichende Laichplätze
- ☐ hohe Fischentnahme durch Fischer
- ☐ hohe Fischentnahme durch Fressfeinde
- ☐ geringer Fischbestand nach einem akuten Fischsterben
- ☐ hohe Chemikalienbelastung
- ☐ schlechte Lebensräume für Jungfische
- ☐ zunehmende Wassertemperaturen
- ☐ hohe Sterblichkeit infolge der Nierenkrankheit PKD
- ☐ Jungfischbesatz ist nie eine gute Massnahme
- ☐ sonstige Gründe, und zwar:

18) Wie gut werden die folgenden Ziele durch Bachforellenbesatz Ihrer Meinung nach erreicht?	voll und ganz	eher ja	teils-teils	eher nein	ganz und gar nicht	Weiss nicht
Mehr Fische für Fischer zu haben	○	○	○	○	○	○
Ausgleich hoher Entnahmemengen durch natürliche Feinde	○	○	○	○	○	○
Ausgleich von Auswirkungen der Fischerei	○	○	○	○	○	○
Ausgleich einer mangelhaften natürlichen Fortpflanzung.	○	○	○	○	○	○
Ausgleich natürlicher Schwankungen in der Bestandsgrösse.	○	○	○	○	○	○
In allen Fliessgewässern Forellen fangen zu können.	○	○	○	○	○	○
Dem Grundsatz „Wer ernten will, muss säen“ zu folgen.	○	○	○	○	○	○
Anderes Ziel, und zwar:	○	○	○	○	○	○

19) Fischbesatz kann nach meiner Meinung im schlimmsten Fall...
(Mehrfachnennungen möglich)

- ☐ Nicht erfolgreich sein
- ☐ Konkurrenz/Wettbewerb innerhalb der Bachforellenbestände hervorrufen
- ☐ Konkurrenz/Wettbewerb zwischen Bachforellen und anderen Fischarten hervorrufen
- ☐ Krankheiten verursachen/verbreiten
- ☐ Die Anzahl natürlicher Feinde erhöhen
- ☐ Zu Kreuzungen zwischen Besatz- und Wildfischen führen
- ☐ Fischbesatz ist immer positiv
- ☐ Weiss ich nicht

Thema: Umwelt, Bewirtschaftung und Grösse von Bachforellenbeständen

Vieles spielt eine Rolle für Bachforellen in Fliessgewässern. In den folgenden Fragen finden Sie eine Auswahl an Themenbereichen, die für viele Fischer eine wichtige Rolle für die Bestandsgrösse spielt.

20) Bitte schätzen Sie nun den **aktuellen Zustand** der folgenden Einflüsse für die **Grösse von Bachforellenbeständen** ein. Für die Grösse von Bachforellenbeständen im [Gewässer] ist/sind...	sehr vorteil-haft	eher vorteil-haft	hat/ haben keinen Einfluss	eher nachteil-haft	sehr nachteil-haft	Gibt es bei uns nicht
...Renaturierungsmassnahmen	○	○	○	○	○	○
...die Anzahl natürlicher Feinde	○	○	○	○	○	○
...die natürliche Fortpflanzung	○	○	○	○	○	○
...Unterstände & Verstecke	○	○	○	○	○	○
...der Grad der Naturnähe des [Gewässers]	○	○	○	○	○	○
...Verbauungen & Schwellen	○	○	○	○	○	○
...die Besatzmassnahmen	○	○	○	○	○	○
...die Fischerei	○	○	○	○	○	○
...die Wasserkraftnutzung	○	○	○	○	○	○
...Schongebiete	○	○	○	○	○	○
...Abwasserreinigungsanlagen/Klärwerke	○	○	○	○	○	○
...Fischtreppen	○	○	○	○	○	○
...die Wasserqualität des [Gewässers]	○	○	○	○	○	○
...der Gesundheitszustand der Fische	○	○	○	○	○	○
...das Nahrungsangebot im [Gewässer]	○	○	○	○	○	○
...der Lebensraum [Gewässer] im Allgemeinen	○	○	○	○	○	○
...Schonmasse	○	○	○	○	○	○
...Schonzeiten	○	○	○	○	○	○
...Fangzahlbeschränkung	○	○	○	○	○	○
Sonstiges:	○	○	○	○	○	○

21) Bei diesen Einschätzungen bin ich mir insgesamt...
○ sehr sicher ○ eher sicher ○ eher unsicher ○ sehr unsicher

Thema: Verein

	immer	oft	manchmal	selten	nie
22) Wie oft wird bei Vereinstreffen über Themen, die mit Fischbesatz zu tun haben, gesprochen?	○	○	○	○	○

23) Ich denke, der Grossteil meines Vereins findet Besatzmassnahmen... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr schlecht	⊢——————————⊣	sehr gut	○

24) In wie weit stimmen Sie folgenden Aussagen zu?	Stimme voll und ganz zu	Stimme eher zu	teils-teils	Stimme eher nicht zu	Stimme ganz und gar nicht zu
Ich halte Wissen und Erfahrungen zu Besatzmassnahmen aus meinem Verein für glaubwürdiger als aus anderen Informationsquellen.	○	○	○	○	○
Der Aufwand, den mein Verein für Besatzmassnahmen betreibt, steht in einem guten Verhältnis zum Ertrag.	○	○	○	○	○
In meinem Verein habe ich die Möglichkeit, mich aktiv an der Besatzplanung zu beteiligen.	○	○	○	○	○

25) An welchen der folgenden Aktivitäten rund um die Fischerei sind Sie aktiv wie häufig beteiligt?	immer	oft	manchmal	selten	nie
elektrischen Kontrollabfischungen	○	○	○	○	○
Besatzfischzucht	○	○	○	○	○
Fischbesatz	○	○	○	○	○
Laichfischfang	○	○	○	○	○

26) Der Einfluss meines Vereins auf meine Meinung zu Fischbesatz ist... Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht			Weiss nicht
sehr gering	├──────────────────────────────────────┤	sehr hoch	○

27) Wie stark beabsichtigen Sie, *künftig* an Besatzmassnahmen teilzunehmen? Bitte markieren Sie die Linie an der Stelle, die am besten Ihrer Meinung entspricht.			Weiss nicht
gar nicht	├──────────────────────────────────────┤	sehr stark	○

Thema: Ergebnisse Besatzstudie

28) Wie schätzen Sie die Ergebnisse der Besatzmarkierungen und Kontrollabfischungen ein?

- ○ Fischbesatz ist erfolgreicher, als ich dachte.
- ○ Der Besatzerfolg passt im Grossen und Ganzen zu meinen Erwartungen.
- ○ Fischbesatz ist erfolgloser, als ich dachte.
- ○ Das weiss ich nicht.

29) Welche Bedeutung haben die Ergebnisse der Abschlussbesprechung für Sie persönlich? Die Ergebnisse...	trifft voll und ganz zu	trifft eher zu	teils-teils	trifft eher nicht zu	trifft ganz und gar nicht zu	Weiss nicht
...regen mich dazu an, über Besatzmassnahmen nachzudenken.	○	○	○	○	○	○
...regen mich dazu an, mit anderen über Besatzmassnahmen zu diskutieren.	○	○	○	○	○	○
...sprechen dafür, dass Fliessgewässer so funktionieren, wie ich denke.	○	○	○	○	○	○
Aufgrund der Ergebnisse muss ich meine Vorstellung zu Fliessgewässern überdenken.	○	○	○	○	○	○

30) Gibt es noch etwas, das Sie uns gerne mitteilen möchten? Fragen, Anregungen und Kritik sind herzlich willkommen!

Herzlichen Dank für Ihre Unterstützung!

XIV.4 Feedback on the 'Type of Angler'

Auf Grundlage der Centrality of Lifestyle Scale (CoL) (Sutton, 2003) wird ein Scalenscore berechnet, der aussagt, wie zentral die Fischerei für eine Person ist. Die Scorebildung basiert auf 9 Items der CoL-Skala, mit jeweils 5-stufigen Antwortmöglichkeiten (Stimme voll und ganz zu, stimme eher zu, teils-teils, Stimme eher nicht zu, Stimme ganz und gar nicht zu). Der Wortlaut der Items ist in Tabelle 22 wiedergegeben.

Table 22 [Appendix].
Formulierung der Centrality of Lifestyle Skala (nach Sutton, 2003) und Zurodnung der Items zu Itemnummern, Mittelwert je Item und Standardabweichung (Schweizweite Stichprobe, N = 398).

Item-Nr.	Formulierung	Mittel-wert*	*SD*
F65_1	Wenn ich mit dem Fischen aufhöre, verliere ich wahrscheinlich den Kontakt zu vielen meiner Freunde.	2.93	1.26
F65_2	Wenn ich nicht fischen gehen könnte, dann wüsste ich nicht, was ich sonst machen könnte.	3.84	1.09
F65_3	Wegen der Fischerei habe ich keine Zeit, an anderen Freizeitaktivitäten teilzunehmen.	3.86	1.12
F65_4	Die meisten meiner Freunde haben in irgendeiner Art und Weise mit Fischerei zu tun.	3.36	1.13
F65_5	Ich halte mich selber für einen Experten in der Fischerei.	2.87	1.01
F65_6	Ich finde, dass ein grosser Teil meines Lebens sich um das Fischen dreht.	2.59	1.18
F65_7	Andere sagen wahrscheinlich, dass ich zu viel Zeit für das Fischen aufwende.	3.08	1.36
F65_8	Ich gehe lieber fischen als irgendetwas anderes zu tun.	2.71	1.20
F65_9	Andere Freizeitaktivitäten interessieren mich nicht so sehr wie das Fischen.	3.03	1.26

** = gemessen auf einer Skala von 1 (Stimme voll und ganz zu) bis 5 (Stimme ganz und gar nicht zu).*

Bevor der Skalenscore gebildet wurde, wurde sowohl eine Reliabiltätsprüfung als auch eine konfirmatorische Faktorenanalyse zur Überprüfung der Skala und Bildung von Gewichten für die einzelnen Items gerechnet.

Die Reliabilitätsprüfung mit SPSS 13 (MAC) ergab ein Cronbach's Alpha von 0.853. Dieser besagt, dass die Items der CoL-Skala relativ gut dasselbe Konstrukt messen. Da Cronbach's Alpha allerdings als Reliabilitätsmass immer stärker in der Kritik steht

(Sijtsma, 2009), wurde zusätzlich mit Mplus 5.21 eine konfirmatorische Faktorenanalyse gerechnet (siehe Figure 37).

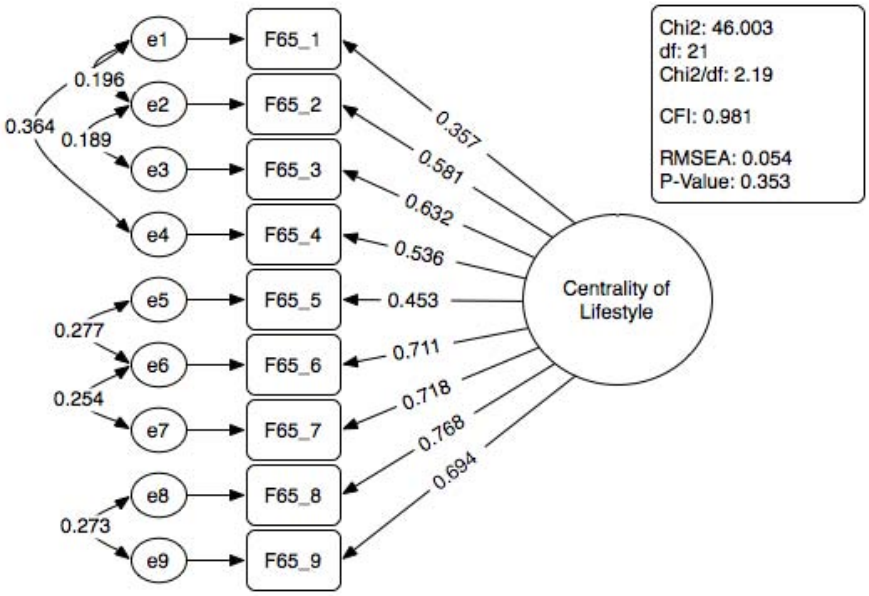

Figure 37 [Appendix]. Konfirmatorische Faktorenanalyse zu Centrality of Lifestyle. Dargestellt sind jeweils die Faktorladungen je Item für die latente Variabel Centrality of Lifestyle sowie die Korrelationen zwischen den Items und die Modell-Fit Kennwerte für die Güte der Passung zwischen den zu Grunde liegenden Daten und der Modelannahme.

Die Model-Fit-Werte für die konfirmatorische Faktorenanalyse liegen innerhalb der akzeptablen Parameter (siehe Hu und Bentler, 1999), nachdem eine Korrelation zwischen mehreren Items zugelassen wurde. Die Korrelationen zwischen den Items sind allesamt eher gering (0.196 – 0.364) und können vermutlich auf die sehr ähnliche Formulierung der Items zurückgeführt werden: Deutlich wird dies bei F65_1 „Wenn ich mit dem Fischen aufhöre, verliere ich wahrscheinlich den Kontakt zu vielen meiner Freunde" und F65_4 „Die meisten meiner Freunde haben in irgendeiner Art und Weise mit dem Fischen zu tun.". Beide Items haben gemeinsam, dass sie die „Freunde" in Verbindung mit der Fischerei stellen und somit eine Korrelation auch inhaltlich nahe liegt. Ähnlich verhält es sich mit den anderen in die Abbildung eingezeichneten Korrelationen.

Die Faktorladungen der Items für die latenten Variable Centrality of Lifestyle sind fast ausschliesslich im guten Bereich (Range: 0.357 – 0.768). Lediglich die beiden Items F65_1 (0.357) und F65_5 (0.453) liegen unter einer Faktorladung von 0.5 und haben damit einen nicht so grossen Einfluss auf die Centrality of Lifestyle.

Insgesamt gesehen kann die Centrality of Lifestyle-Skala als durchaus reliabel angesehen werden. Für die Bildung eines Summenscores über die Skala werden die Antworten mit der jeweiligen Faktorladung multipliziert und dann aufaddiert, so dass der Score nach Einfluss der einzelnen Items gewichtet wird. Damit ergeben sich für die Centrality of Lifestyle ein Maximalwert von 27.25 (Angelfischerei ist auf ganzer Linie nicht zentral) und ein Minimalwert von 5.45 (Angelfischerei ist in jeder Hinsicht bestimmend). Der Mittelwert der Skala liegt bei 17.06 (*SD* 4.53). Der numerisch höhere Wert steht für eine geringere Centrality of Lifestyle aufgrund der internen Codierung der Skalenintems.

Für die Schweizweite Befragung ergibt sich folgende Häufigkeitsverteilung der Centrality of Lifestyle (Figure 38):

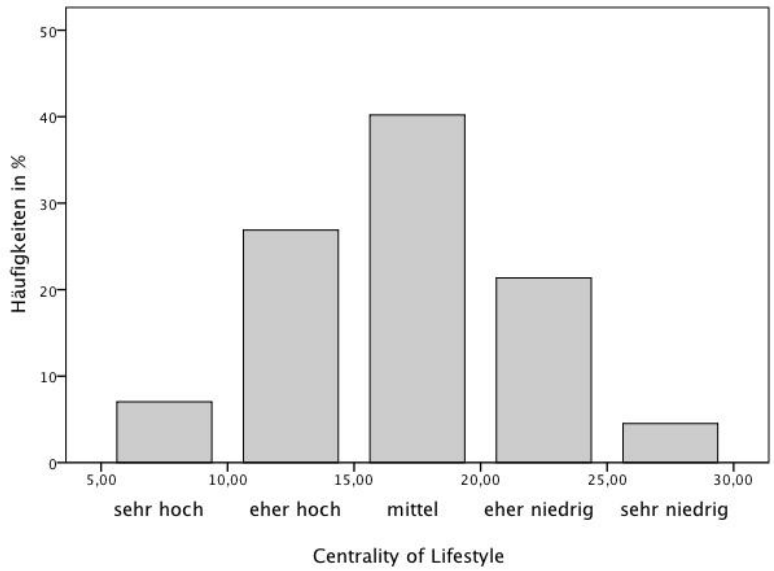

Figure 38 [Appendix]. Häufigkeitsverteilung der Summenscores für die latente Variable Centrality of Lifestyle. Je geringer der Score ist, desto zentraler ist die Angelfischerei für eine Person. Alle Angaben sind absolute Häufigkeiten.

Um eine allgemeine Rückmeldung zu geben, wurden die Summenscores in 5 Kategorien wie folgt aufgeteilt (siehe Tabelle 23):

Table 23 [Appendix].
Zuordnung von Typen zu den kategorisierten Summenscores für die latente Variable Centrality of Lifestyle.

Typ I	Typ II	Typ III	Typ IV	Typ V
5.51 – 9.50	9.51 – 14.40	14.51 – 19.50	19.51 – 24.50	24.51 – 29.50
sehr hohe CoL	eher hohe CoL	mittlere CoL	eher geringe CoL	sehr geringe CoL

Zu jeder dieser 5 Kategorien wurde ein Rückmeldungstext verfasst, der den jeweiligen Anglern zurückgemeldet wird und ihm/ihr eine Einschätzung gibt, wie zentral das Angeln für sie/ihn ist (siehe Abschnitt Kurzbericht Schweizweite Fischerbefragung).

Diese Texte wurden je nach Skalenscore an die einzelnen Personen als Serienbrief zurückgemeldet. Zusätzlich werden noch Informationen zur Soziodemographie (Alter, Fischererfahrung, Berufsfeld, hauptsächlich genutzter Gewässertyp und Häufigkeit regelmässig befischter Kantone) in den Kurzbericht aufgenommen (siehe nächste Seite).

Dübendorf, XX.XX.2009

[Anschrift]

Sehr geehrte/r Herr/Frau Fischer,

vielen Dank, dass Sie sich die Zeit genommen haben und vor ca. einem halben Jahr unseren sehr lange Fragebogen zur Fischerbefragung ausgefüllt haben. Sie haben uns damit sehr unterstützt und dank Ihrer Hilfe haben wir nun ein gutes Bild, was aus der Sicht von Schweizer Fischerinnen und Fischern die wichtigsten Themen bei Fliessgewässern, deren Bewirtschaftung und dem Fischen sind. Damit ist der erste Schritt getan, die wissenschaftlichen Sichtweisen und Erfahrungen mit denen der Praktiker auf Gemeinsamkeiten und Unterschiede hin anzuschauen.

Als kleines „Dankeschön" für Ihre Mühe haben wir Ihnen ja eine Rückmeldung zu der Befragung versprochen. Aus diesem Grund haben wir Ihnen einen kleinen Bericht mit einigen Ergebnissen der Befragung und einer Rückmeldung zu ihrem „Anglertyp" zusammengestellt.
Da wir aufgrund der Befragung sehr umfangreiche Informationen erhalten haben, sind wir weiterhin mit der Gesamtauswertung beschäftigt. Aktuelle Information zum Stand unserer Studie können Sie im Internet unter http://www.fischer.eawag.ch erfahren oder wenn Sie spezielle Fragen haben, können Sie auch gerne mit uns in Kontakt treten.

Sollten Sie Fragen zu diesem Bericht haben und/oder weitere Details wissen wollen, sind wir gerne unter folgender Adresse für Sie da:

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Kurzbericht Schweizweite Fischerbefragung 2008/2009

Insgesamt haben 418 Fischer und Fischerinnen aus der französischsprachigen und deutschsprachigen Schweiz den Fragebogen ausgefüllt und an uns zurückgesendet. An der Befragung haben sowohl „alte Hasen" als auch sehr junge Fischer teilgenommen. In Abbildung 1 haben wir dargestellt, welche Geburtsjahrgänge in unserer Befragung wie häufig vertreten sind.

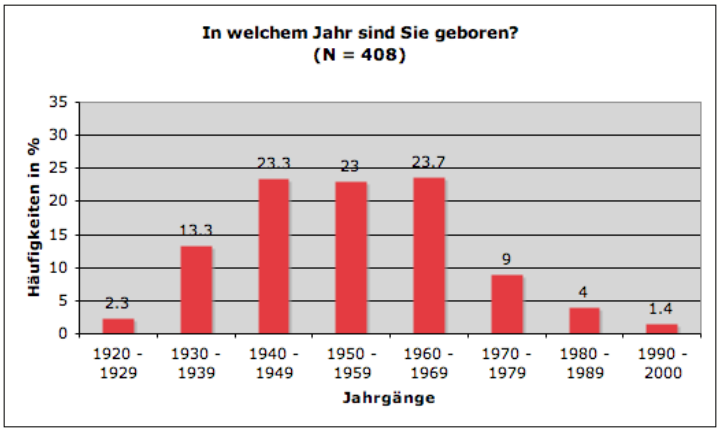

Abbildung 1: Antworten auf die Frage: „In welchem Jahr sind Sie geboren?" Die Geburtsjahrgänge sind in Prozent dargestellt.

Insgesamt haben 408 von 418 Umfrageteilnehmern die Frage nach dem Geburtsjahrgang beantwortet. Der Grossteil der Befragten wurde zwischen 1940 und 1969 geboren.

Zusätzlich haben wir gefragt, seit wie vielen Jahren aktiv gefischt wird. Die meisten der befragten Fischer können als (sehr) erfahren bezeichnet werden. In Abbildung 2 haben wir die Ergebnisse für Sie als Balkendiagramm dargestellt.

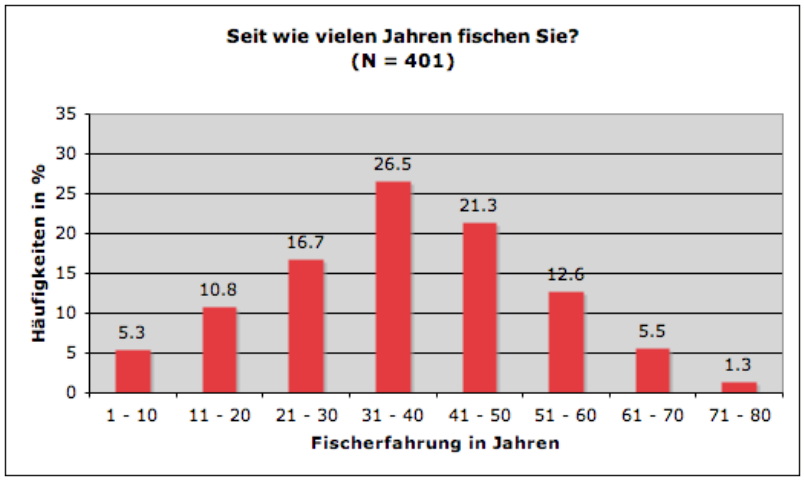

Abbildung 2: Erfahrung als Fischer/Fischerin in Jahren. Alle Angaben in Prozent.

Die Spannbreite der Erfahrung mit dem Fischen ist sehr gross: sie reicht von 1 Jahr bis hin zu 80 Jahren. Die meisten Fischer, die an unserer Studie teilgenommen haben, sind seit 31 – 40 Jahren aktive Fischer.
Darüber hinaus haben wir danach gefragt, in welchem Berufsfeld Schweizer Fischer und Fischerinnen tätig sind (siehe Abbildung 3 auf der nächsten Seite).

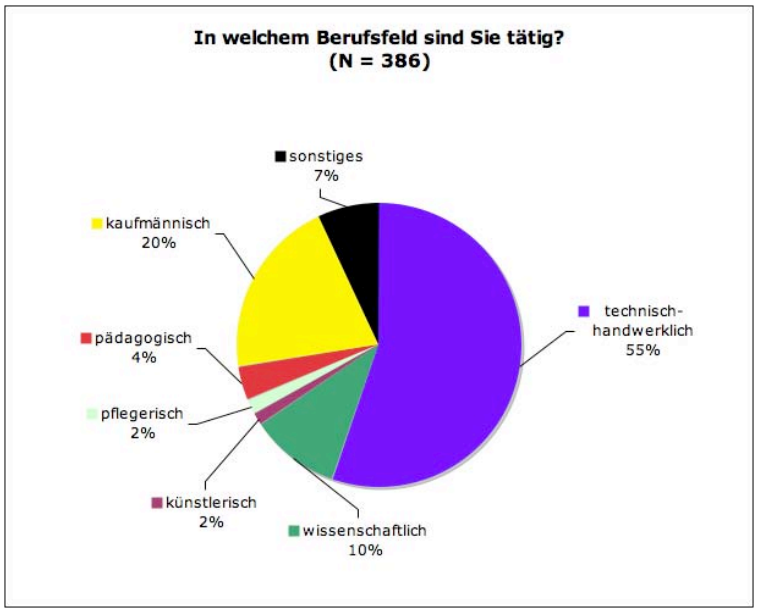

Abbildung 3: Aufteilung der befragten Fischer nach Berufsfeld. Alle Angaben in Prozent.

386 von 418 befragten Fischerinnen und Fischern haben auf die Frage nach dem Berufsfeld geantwortet. Die beiden häufigsten Berufsfelder sind „technisch-handwerklich" (55%) und „kaufmännisch" (20%). Auf dem dritten Platz ist das wissenschaftliche Berufsfeld zu finden, das von 10% der Fischer angegeben wurde. Pädagogische, pflegerische und künstlerische Berufsfelder bilden das Schlusslicht mit je 4% bzw. 2% Nennungen. 7% gaben an, in einem sonstigen Berufsfeld tätig zu sein.

Die Frage nach dem hauptsächlich genutzten Gewässertyp wurde von 317 von 418 Fischern beantwortet (siehe Abbildung 4)

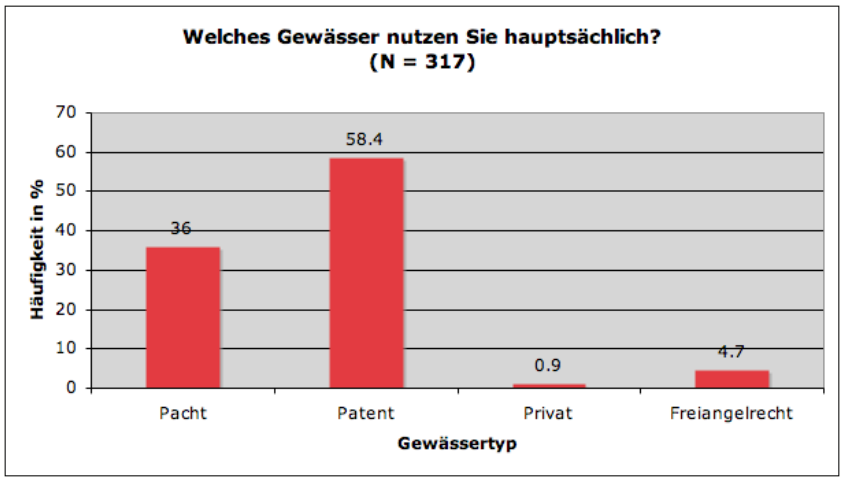

Abbildung 4: Prozentuale Darstellung der Nutzung verschiedener Gewässertypen.

Ein Grossteil der Befragten (58.4%) fischt in Gewässern, für die zuvor beim Kanton ein Patent erworben werden muss. 36% fischen in Pachtgewässern. Nur ein sehr geringer Prozentsatz nutzt das Freiangelrecht (4.7%) oder Privatgewässer (0.9%).

Eine weitere spannende Frage ist, in welchen Kantonen die Umfrageteilnehmer wie häufig fischen. Die Auswertung ergab, dass fast jeder Kanton in unserer Befragung vertreten ist. Lediglich Appenzell-Innerrhoden wurde von keinem Fischer als regelmässiges Fischgebiet genannt. Insgesamt haben 415 Fischer durchschnittlich 1-2 Kantone genannt, in denen sie regelmässig fischen. Absoluter Spitzenreiter ist der Kanton Bern mit 20% Nennungen, gefolgt vom Aargau (15.2%) und Thurgau (12.8%). In Abbildung 5 auf der nächsten Seite haben wir die Angelhäufigkeit in den Kantonen farblich in eine Karte der Schweiz eingezeichnet.

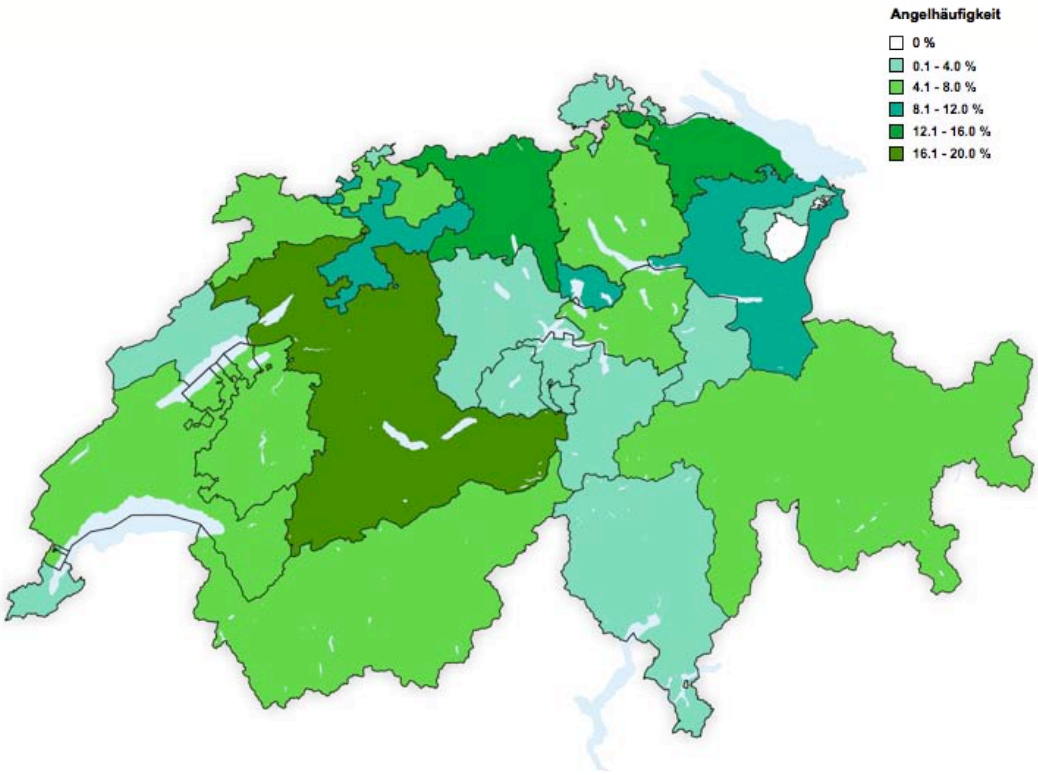

Abbildung 5: Karte der Kantone der Schweiz. Je dunkler die Farbe der Kantone ist, desto häufiger wurde angegeben, dass in dem entsprechenden Kanton regelmässig gefischt wird.
Quelle für Karte: http://de.wikipedia.org/wiki/Datei:Karte_Kantone_der_Schweiz_2007.png

Über diese allgemeinen Angaben hinaus möchten wir Ihnen auch gerne noch eine Rückmeldung geben, welcher „Anglertyp" Sie sind. In Fischer-Befragungen, die z.B. in Deutschland oder den USA durchgeführt wurden, zeigte es sich immer wieder, dass es nicht „den Fischer" gibt, sondern es werden jeweils verschiedene „Anglertypen" gefunden. Unterscheidungen können z.B. darauf basieren wie wichtig der Verzehr gefangener Fische für den einzelnen ist oder welchen Stellenwert das Hobby Fischen im Leben einer Person einnimmt. Der „Anglertyp" in diesem Bericht basiert auf verschiedensten Angaben, die Sie im Fragebogen gemacht haben und soll aussagen wie zentral das Fischen für die Freizeit und das Leben ist. Auch wenn nicht jedes Detail auf Sie persönlich zutrifft, sollte zumindest die Tendenz stimmen.
Unsere Auswertung hat ergeben, dass folgender Anglertyp am besten zu Ihnen passt:

[TYP]

Eine Beschreibung Ihres Anglertyps können Sie in folgender Tabelle nachlesen (siehe nächste Seite).

Typ I	**Das Fischen ist für Ihre Freizeit und Ihr Leben sehr zentral.** Die Angelfischerei hat in Ihrem Leben und Ihrer Freizeit den höchsten Stellenwert. Keine andere Freizeitaktivität interessiert Sie so sehr wie das Fischen und Sie nutzen jede Gelegenheit, um Ihrer Leidenschaft nachzugehen. Wind und Wetter machen Ihnen am Gewässer nichts aus und mit Sicherheit sind Sie der erste Fischer früh morgens am Gewässer. Die Wahrscheinlichkeit ist sehr hoch, dass Freunde und Bekannte Sie eher an Ihrem Lieblingsgewässer antreffen als bei Ihnen Zuhause. Sie sind mit Leib und Seele Fischer, und es gibt niemanden in Ihrem Umfeld, der dies nicht weiss.
Typ II	**Das Fischen ist für Ihre Freizeit und Ihr Leben zentral.** Die Angelfischerei hat in Ihrem Leben und Ihrer Freizeit einen hohen Stellenwert. Kaum eine andere Freizeitaktivität interessiert Sie so sehr wie das Fischen und Sie nutzen oft die Gelegenheit, um Ihrer Leidenschaft nachzugehen. Wind und Wetter machen Ihnen am Gewässer eher selten etwas aus und sicherlich kommt es ab und zu vor, dass Sie der erste Fischer früh morgens am Gewässer sind. Die Wahrscheinlichkeit ist eher hoch, dass Freunde und Bekannte Sie häufiger an Ihrem Lieblingsgewässer antreffen als bei Ihnen Zuhause. Sie sind gerne Fischer, und es gibt kaum jemanden in Ihrem Umfeld, der dies nicht weiss.
Typ III	**Das Fischen ist für Ihre Freizeit und Ihr Leben in mancher Hinsicht zentral.** Die Angelfischerei hat in Ihrem Leben und Ihrer Freizeit einen mittleren Stellenwert. Das Fischen gehört zu den Freizeitaktivitäten, die Sie interessieren, aber Sie haben auch noch andere Hobbies, denen Sie mindestens genauso gerne nachgehen. Sie nutzen nicht jede Gelegenheit, um Fischen zu gehen, sondern Sie gehen nur, wenn Sie gerade in der richtigen Stimmung sind und keine wichtigeren Aufgaben auf Sie warten. Wind und Wetter machen Ihnen am Gewässer in der Regel nichts aus und bisweilen kommt es vor, dass Sie der erste Fischer früh morgens am Gewässer sind... sofern Sie sich dazu entschieden haben, an diesem Tag fischen zu gehen. Es kommt ab und zu vor, dass Freunde und Bekannte Sie eher an Ihrem Lieblingsgewässer antreffen als bei Ihnen Zuhause. Sie sind gerne Fischer, aber Sie würden nicht wichtige Aufgaben vernachlässigen, um Fischen gehen zu können.
Typ IV	**Das Fischen ist für Ihre Freizeit und Ihr Leben eher nicht zentral.** Die Angelfischerei hat in Ihrem Leben und Ihrer Freizeit einen eher geringen Stellenwert. Das Fischen gehört zu den Freizeitaktivitäten, die Sie interessieren, aber Sie haben auch noch andere Hobbies, die Sie teilweise stärker als das Fischen interessieren. Sie nutzen nicht jede Gelegenheit, um Fischen zu gehen, sondern Sie gehen üblicherweise nur, wenn Sie gerade in der richtigen Stimmung sind und keine anderen Aufgaben auf Sie warten. Die Wahrscheinlichkeit ist gering, dass Freunde und Bekannte Sie eher an Ihrem Lieblingsgewässer antreffen als bei Ihnen Zuhause. Sie gehen gelegentlich – und gerne – fischen, aber Sie würden dafür nicht alles tun oder andere Aufgaben vernachlässigen.
Typ V	**Das Fischen ist für Ihre Freizeit und Ihr Leben nicht zentral.** Die Angelfischerei hat in Ihrem Leben und Ihrer Freizeit einen geringen Stellenwert. Das Fischen gehört zu den Freizeitaktivitäten, die Sie zwar interessieren, aber Sie haben auch noch andere Aufgaben, mit denen Sie sich öfter als mit dem Fischen beschäftigen. Sie nutzen eher selten die Gelegenheit Fischen zu gehen. Sie gehen nur, wenn Sie gerade in der richtigen Stimmung sind und keine anderen Aufgaben zu erledigen haben bzw. andere Dinge gerade wichtiger sind. Die Wahrscheinlichkeit ist sehr gering, dass Freunde und Bekannte Sie eher an Ihrem Lieblingsgewässer antreffen als bei Ihnen Zuhause. Sie gehen gelegentlich fischen, aber nur, wenn wirklich Zeit dafür ist und Sie dadurch keine anderen Aufgaben vernachlässigen.

Wir hoffen, dass Sie diesen Kurzbericht interessant fanden und wünschen Ihnen auch für die Zukunft viel „Petri Heil!"

Wenn Sie Interesse an einem ausführlicheren Bericht oder spezielle Fragen an uns haben, können Sie mit uns unter folgender Anschrift in Verbindung treten:

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Oder besuchen Sie unsere Internetseite http://www.fischer.eawag.ch. Auf der Seite informieren wir über den aktuellen Projektstand und nächste Projektschritte.

Mit freundlichen Grüssen,

Eike von Lindern Susanne Haertel-Borer

XV. Curriculum Vitae

Eike von Lindern

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Geburtsdatum/-ort	15.07.1977 in Wildeshausen, Deutschland
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Sprachen	Englisch, Schwedisch

Schulbildung:

1984-1988	Grundschule Dötlingen, Deutschland
1988-1990	Orientierungsstufe Wildeshausen, Deutschland
1990-1997	Gymnasium Wildeshausen, Deutschland, Abschluss Abitur

Zivildienst:

08/1997–09/1998	Malteser Hilfsdienst e.V., Wildeshausen, Deutschland

Studium:

10/1998-11/2006	Studium der Psychologie an der Carl von Ossietzky Universität Oldenburg, Deutschland. Abschluss: Diplom
06/2006	Abgabe der Diplomarbeit „Ein Vergleich von Internet- und Paper&Pencilfragebögen am Beispiel der Beurteilung von Kunst und Architektur“
09/2007 – 09/2010	Doktoratsstudium an der Universität Zürich, Fachrichtung Sozialpsychologie
08/2010	Voraussichtliche Abgabe der Dissertationsschrift „ Changing Mental Models to Promote Pro-Environmental Ecosystem Management: Recreational Fishermen and Their Fish Stocking Practices in Swiss Running Waters“

Hauptberufliche Tätigkeiten:

10/2006–09/2007	Mitarbeiter bei der Weinreich Unternehmensberatung GmbH, Donnerschweer Str. 91, 26123 Oldenburg
09/2007–11/2010	Doktorand bei der Eawag, Überlandstr. 133, CH-8600 Dübendorf
11/2010 –	Wissenschaftlicher Mitarbeiter am WSL, Zürcherstrasse 111, CH-8903 Birmensdorf

Nebentätigkeiten:

1999–2001	Studentische Hilfskraft im DFG geförderten Forschungsprojekt „Visuell-taktile Interaktion“, Universität Oldenburg
2001–2006	Studentische Hilfskraft bei der Weinreich Unternehmensberatung GmbH, Oldenburg.
2004–2006	Übungsleiter im Hochschulsport der Universität Oldenburg
01/2009–06/2010	Ombudsmann für PhD-Studierende an der Eawag, Dübendorf

Fort- und Weiterbildung:

2006	Teilnahme an dem Seminar „Besprechungen moderieren und effizient leiten“
2009	Teilnahme an der ECPR Summer School in Methods and Techniques, University of Ljubljana, Faculty of Social Science. Thema: „Confirmatory Factor Analysis and Structural Equation Modelling“. Dozenten: Peter Schmidt, Eldad Davidov.
2009	Teilnahme am Fortbildungskurs „Writing Research Papers for Publication“, Universität Zürich. Dozentin: Dr. Wendy Swanson.
2010	Voraussichtliche Teilnahme am Workshop „Theory of Planned Behaviour“, Psychologisches Institut, Universität Zürich. Dozenten: Icek Ajzen, Peter Schmidt.

Weitere praktische Erfahrungen:

02/2005	Vortrag „Das Leben in der Stadt aus umweltpsychologischer Sicht“ im Studiengang „Landschaftsökologie“ an der Carl von Ossietzky Universität Oldenburg
11/2005	Durchführung des Seminars „Gewaltprävention und Selbstbehauptung“ für die Diakonischen Werke Oldenburg, Deutschland.
2008	Mitarbeit am Projekt „Wer kann am besten überzeugen?“ bei der Nacht der Forschung, Zürich.
10/2009 – 01/2010	Durchführung und Auswertung einer Doktorandenbefragung zum Thema „Arbeitsbelastung und Zufriedenheit“ an der Eawag
2009	Mithilfe bei der Durchführung des „9. Kongress für Gesundheitspsychologie“, Universität Zürich.
2009	Mithilfe bei der Organisation und Durchführung der „8th Biennial Conference of the German Environmental Psychology Division“, Universität Zürich.
03/2010 – 04/2010	Planung und Durchführung von 6 Angler-Workshops anlässlich des Projektabschlusses „Erfolgskontrolle Bachforellenbesatz“.

EDV-Kenntnisse:

MS-Office (Sehr gut)
SPSS (Sehr gut)
Turbo Pascal (Befriedigend)
HTML (Grundlagen)
R (Grundlagen)
Mplus (Gut)

Interessen:

	Sport (Kampfkunst, Joggen, Radfahren)
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	Fotografie

Engagement:

seit 2001	Mitglied beim BUND e.V.
2003	Gründung des gemeinnützigen Sportvereins „Shio-Sai e.V.“
2003 – 2007	Vorstandsmitglied des Shio-Sai e.V.
2005 – 2007	Inhaber des „Ehrenamtspasses“ der Stadt Oldenburg
2006 – 2008	Inhaber der „SportEhrenamtsCard“ des Landessportbund Niedersachsen e.V.

Wissenschaftliche Artikel

von Lindern, E., Haertel-Bohrer, S.S., Mosler, H.-J. (submitted). How do Stakeholders' Mental Models Impact Ecosystem Management Preferences?

von Lindern, E., Mosler, H.-J. (submitted). Do Mental Models Matter for Ressource Management?

von Lindern, E., Haertel-Bohrer, S.S. (submitted). Trout Biology, Habitat Requirements and Fisheries Management in the Perception of Anglers.

von Lindern, E., Mosler, H.-J. (in preparation). The Role of Experience for Mental Models: Applying Mental Models-Derived Tailored Interventions.

Bücher

Weinreich, U., von Lindern, E. (2008). Praxisbuch Kundenbefragungen. München: Moderne Industrie.

Nichtwissenschaftliche Artikel

von Lindern, E., Weinreich, U. (2003) *Durchführung von Mitarbeiterbefragungen.* In: S. Jahnes, T. Schüttelhelm (Hrsg.) *Praxislösungen – Integrierte Management-systeme IMS.* (Kapitel 7.6, 15. Aktualisierungslieferung). Augsburg: WEKA.

von Lindern, E. (2005) *Umweltwahrnehmung.* In: M. Fansa (Hrsg.) *Das Jahrhundertprodukt: Oldenburger Landschaften 1905 bis 2005 – und dann?* (S. 45–57). Oldenburg: Isensee.

von Lindern, E., Weinreich, U. (2006) *Innovations- und Ideenmanagement.* In: S. Jahnes, T. Schüttelhelm (Hrsg.) *Praxislösungen – Integrierte Managementsysteme IMS.* (Kapitel 4.10, 27. Aktualisierungslieferung). Augsburg: WEKA.

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07/2008 20th Conference of the International Association for People and Evironment Studies (IAPS), Rome, Italy.
Vortrag: „The Use of Mental Models for a Better Understanding of Human Behviour Regarding Aquatic Ecosystems“

08/2008 20th Biennial Congress of the International Association of Empirical Aesthetics (IAEA), Chicago, IL, USA.
Vortrag: „Is the Aesthetic Judgement of Museum Visitors Biased If Rating Well-Known Objects?“

09/2008 EAWAG Actionfield Day 2008, Dübendorf.
Vortrag: „Trout Stocking Revisited: An Interdisciplinary Approach to Stakeholder Participation and Co-management“

05/2009 Tagung der kantonalen Fischereiverwaltungen (BAFU), Schaffhausen.
Vortrag: „Projekt Besatzkontrolle“

07/2009 11th Congress of Psychology, Oslo, Norway.
Vortrag: „Mental Models of Aquatic Ecosystems and Their Impact on Trout-Stocking Behaviour“

08/2009 Tagung der Schweizerischen Vereinigung der Fischereiaufseher, Untersiggenthal.
Vortrag: „Projekt Fischbesatz und Erfolgskontrolle“

09/2009 8th Biennial Conference of the German Environmental Psychology Division, Zürich.
Vortrag: „Mental Models About the Aquatic Ecosystem and Their Impact on Attitude Towards Fishstocking“

09/2009 EAWAG Actionfield Day 2009.
Poster: „Trout unlimited? Anglers' Perception of Aquatic Ecosystems“

10/2009 Modellierworkshop EAWAG.
Vortrag: „Anglers and Fish Stocking Behaviour: A SEM Approach“

10/2009 Mittelbaukolloquium des Psychologischen Instituts, Universität Zürich.
Vortrag: „Nachhaltiges Ökosystemmanagement durch die Veränderung mentaler Modelle von Stakeholdern“

07/2010 27th International Congress of Applied Psychology, Melbourne, Australia.
Vortrag: „The Impact of Swiss Anglers' Mental Models on Perceived Risks and Benefits of Fish Stocking Behaviour“

09/2010 EAWAG Actionfield Day 2010.
Poster: „The impact of stocking success feedback on anglers' fisheries management beliefs“

09/2010 Vorstellung der Dissertation, EAWAG.
Vortrag: „Changing Mental Models to Promote Pro-Environmental Ecosystem Management: Recreational Fishermen and Their Fish Stocking Practices in Swiss Running Waters“